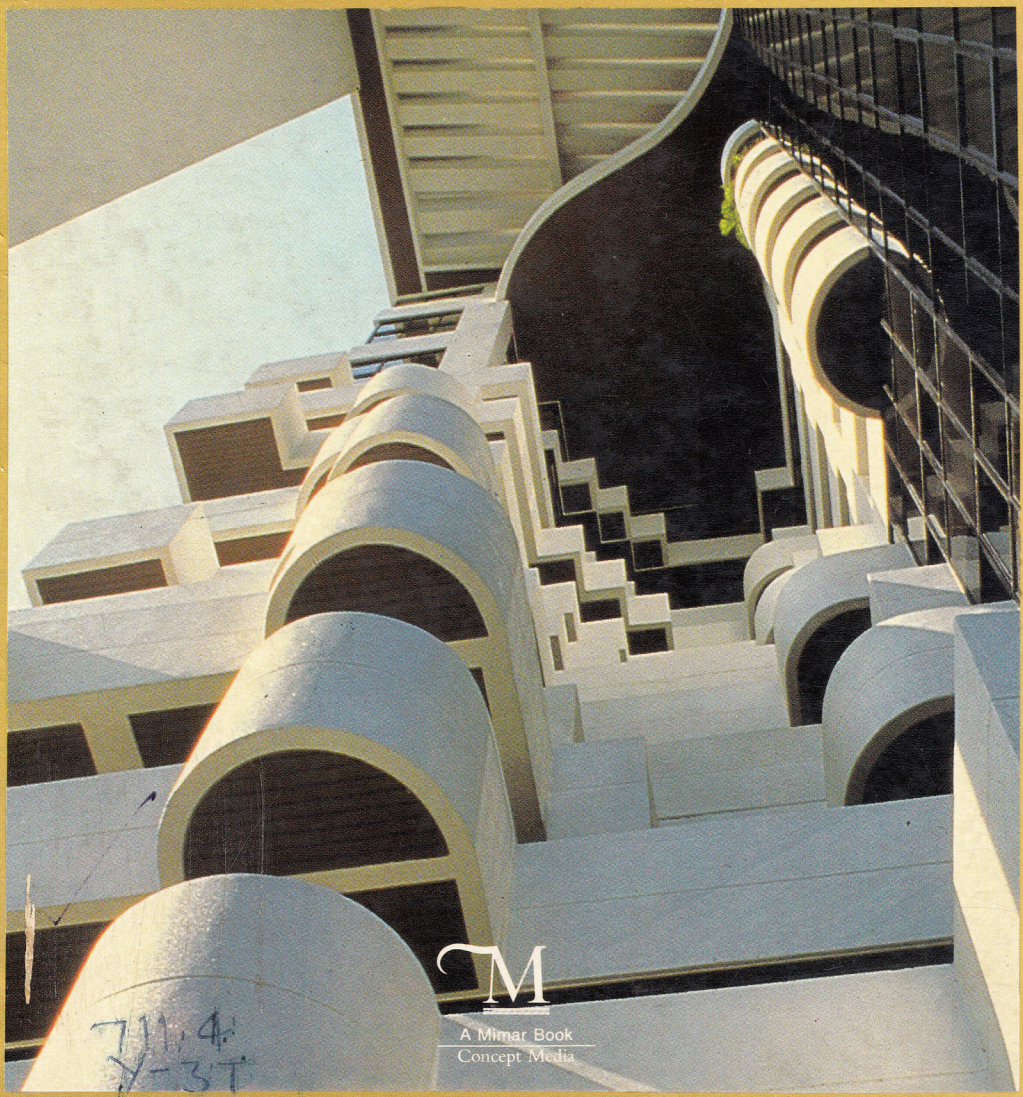
TROPICAL URBAN REGIONALISM

BUILDING IN A SOUTH-EAST ASIAN CITY

Ken Yeang



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In *Tropical Urban Regionalism*, Ken Yeang gives insights and ideas for building in the urban contexts in the South-East Asian region. He explains how local factors such as climate and culture are important design influences. The argument is advanced for architects and urbanists in the Asian region to provide the built environments that represent their own goals and identities.

He gives a critical review and defines the bases for the regionalist approach. Architecture's function is perceived as one of "relating its attributes as a technological product to a particular place and time and as a vital connector that links technology with culture". The regionalist design approach seeks to articulate this linkage. These linkages and the form that they might take are explored and illustrated here with built examples. The book provides a valuable point of reference for architects, students of architecture and of related fields, and for the reader researching the architectural typology of developing countries.

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BUILDING IN A SOUTH-EAST ASIAN CITY

Dedicated to my mother, Louise.

A Mimar Book

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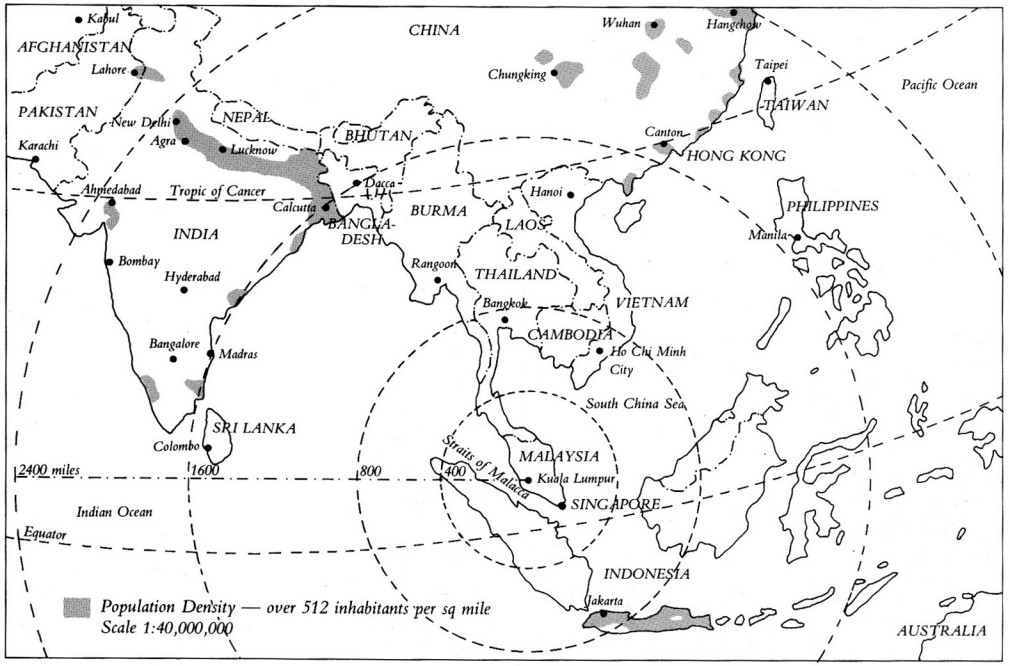
1 On Building and Thinking

The Asian Context

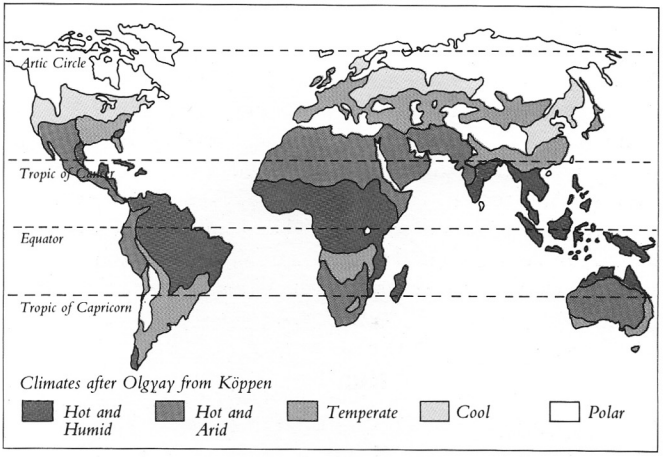
The arguement might be advanced for architects in the developing world to produce built environments which authentically express their goals and identities that relate to place and time. In the Asian region where in instances, intensive urbanisation is taking place, the theoretical bases and icons for regionalist architecture must develop concurrent with rapid building activity.

In situations where research and an investigative design process take place concurrently with practice, the level of experimentation obviously cannot be expected to be rigorously consistent or sequential. The tribulations of architectural practice, unlike academic research conditions, do not generally permit with certainty a full control of experimentation, even over a collective set of commissions. Often the external economic pressures of the building programme compel the architect to make formal design decisions and proceed regardless of whether the developmental process in his scheme of ideas is fully completed. If he were to sustain a continuity in his own formulation of constructs (outside that of the particular building programme) in the ensuing process, then he would need to treat each of his design assignments,



regardless of size and complexity, as a likely opportunity to demonstrate an ideal and having the potential to enable the extension of a previous set of ideas such that each subsequent design can develop progressively over a number of preceding related ideas.

Invariably, the size and the requirements of each building programme differ, and the architect has to work to the best with whatever is at hand. On occasions he might have to defer an important idea or its progressive development no matter how promising, when the design is found to be unacceptable to the client or inappropriate to the project programme. Provided that the confines of the area of investigation is rigorously maintained



The Equatorial Belt
The developing countries in Asia lie along the Equatorial belt in which 35% live in urban areas. The impact of development, and the emergence of the sovereign state brought a spirit of assertion and confidence. Following reaction against Modernism, this spirit generated a nationalistic pursuit for identity.

Kuala Lumpur
Kuala Lumpur lies 3 degrees north of the Equator. It is by comparison a relatively small Asian city, but Malaysia's largest and covering an area of 96 square miles with a population of nearly a million.

throughout, the expected consequences of a converging developmental programme which involves both building and the formulating of premises might be the generation of a more or less consistent set of outputs that can be held to constitute a *series*.

Developmental work survives better in an environment of active discourse. However, contemporary discourses still centre around Western Europe, Japan and the U.S., leaving much of Asia in the architectural backwaters of debate. There is also not enough thought being given to the architecture of the tropics, particularly urban architecture. A more equable emphasis might now be timely, especially since the equatorial belt between the Tropics of Cancer and Capricorn contain the majority of Asia's axis of developing countries which are currently experiencing varying levels of increased urban development. What is also apparent is that many of the buildings in the region have been largely derived or copied from contemporary models imported from the West.

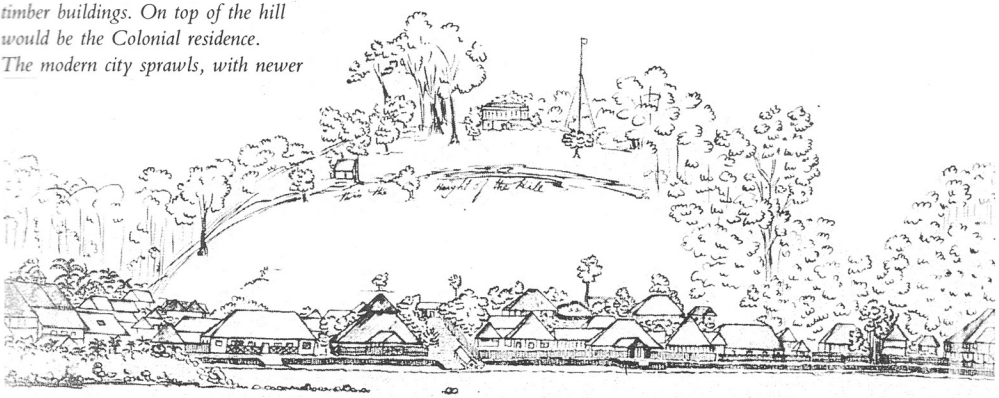
Existing built precedents for an urban architecture that performs and belongs to the region are insufficient to provide the necessary icons and models. The physical consequences of this are self evident. Some of Asia's cities today have become so homogeneously internationalised that they have lost most of the characteristics that made them in the first instance Asian, unique and indigenous to the place. What we need is a directed instructive basis for regionalist design with an urban priority.

Initially we need to formulate and substantiate those considerations that constitute the regionalist design approach. These premises are examined here in the form of a set of connec-

The Universal Skyline
Above: Singapore Skyline
Right: Sydney Skyline
Style importation changed many developing Asian cities into places that deny their cultural roots. They appear homogeneous and could be anywhere. Expedient response of building global architecture destroyed the regional environments. Variety and complexity of streets and buildings have been removed and replaced by buildings with no identity and context. Skylines and streetscapes have become universal.

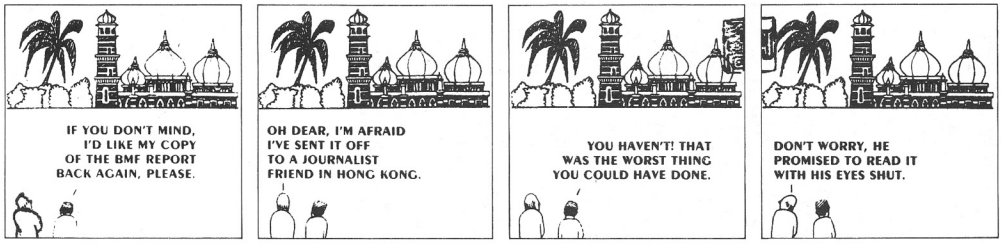
The Internationalising of the Asian City

Below: Early Kuala Lumpur.
Bottom: Modern Kuala Lumpur.
Early Kuala Lumpur consisted of timber buildings. On top of the hill would be the Colonial residence. The modern city sprawls, with newer buildings located along the Hotels belt. Much of the shophouses and residences, have given way to intensively-developed isolated structures derived largely from international influences.



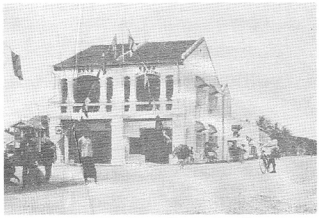
tions that the architecture should make with the place in which it is located. The connections are those that are made in the design process. The architect has to critically determine those linkages that are right for that particular place and time, and synthesise them, with the other aspects of the building programme, into built form. However, to avert a deterministic adherence to a particular preconceived style, form or technology, we also need a concept of the building enclosure that can serve as an armature for design. This must be sufficiently general to permit design explorations of regionalist intentions. Furthermore, the armature must be able to include holistically not only the tropical aspects of the building programme but also urban and other considerations. It is contended here that this goal might be best achieved by employing a systemic proposition of the attributes of the building enclosure. The building enclosure in the tropics might be regarded as an *environmental filter* whose systemic functions are to sieve the external climate and the internal environment. In this regard, the building envelope serves as a

A Caricature of the City
Right: Masjid Jamik.
Below: The cartoonist's image.
The city of Kuala Lumpur was founded at the confluence of the rivers, the Sungei Gombak and the Sungei Klang. At the point of confluence is the mosque, Masjid Jamik with its identifiable domes, minarets, white spandralled arches and the distinctive horizontally striped, brick and plaster elevations.
The image of this mosque located at the point of the founding of Kuala Lumpur is used by the cartoonist, Hung Mo Kwai (Asian Wall Street Journal) as a self-evidently identifiable caricature of the city.



mediating barrier between man and nature. This proposition and its consequences for regionalist design are discussed. The intention is not to provide a prescriptive manual for the design of urban regionalist buildings in the tropics. The analytical and quantitative aspects of designing with climate are handled more extensively elsewhere. The proposition simply provides an analogy that can be used for design synthesis and for use in the analysis of the architectural heritage.

A number of built configurations are explored here concurrent with the premises and concepts discussed. These are a series of possible interpretations of the implications of the ideas and propositions. By being work-in-progress, the designs and buildings cannot be held as being definitive nor conclusive but serve as a monographic set of designs and buildings recording the cycle of work. The aspiration is that these ideas, propositions and the exemplary series would in totality provide a directive for a programme for action for others carrying out a similar pursuit as well as, the basis for the further development of these ideas.



The Malaysian Streetscape
Far left: The traditional Chinese shophouse.
Left: The petty trader and street hawker.
Left, below: The contemporary hawker stall.
Early urban buildings of timber gave way to use of masonry in shophouses. Crucial components of early streetscape are petty traders and hawkers who ply their trades in the narrow streets, and in the 5-foot walkways. In contemporary situation, the hawkers shifted to edges of the city and designated hawker areas. Serving much the same functions, the contemporary stalls developed in this instance, to have flip-up awnings supported by demountable struts which fold down to provide security-panels to serving counter. These are flexible structures that fulfil the enclosural needs in the hot-humid climate.

2 Regionalist Design Intentions

Regionalist architecture seeks to incorporate in its design the 'spirit' of the place in which it is located. Its intentions are for a contextual architecture which responds self-evidently to the local conditions. It should relate to the deeper sensibilities and tangible realities of the place, rather than relating primarily to international influences and trends. More specifically, *the emergent regionalist architecture seeks its architectural significance through relating its built configuration, aesthetics, organisation and technical assembly and materials to a certain place and time.*

This endeavour is both cultural and technical. A particular place would have a physical, social, economic and political status quo besides a cultural and architectural heritage, and natural history. Architecture's function in relating its attributes as a technological product to a particular place and time is as a vital connector that links *technology* with *culture*. The regionalist design approach seeks to articulate this linkage.

The design process should involve the synthesis of the selective combination of a series of functional connections together into built form. These connections include: *a direct connection* which involves the direct creative development and adaptation for contemporary uses of the existing range of built forms, devices, patterns and aethetics that can be identified from the cultural tradition and architectural heritage of the place; *an indirect (abstract) connection* through the interpretation into form by design of those general principles and lessons derived through an analysis of the cultural tradition and architectural heritage of the place; *an inclusive contemporary connection* in design through the selective use and localisation of current technology, forms and ideas that are relevant to the programme and context; *a landscape connection* in the design that reflects, incorporates and integrates the built configuration with the physical features and natural history of the place (that must include its climate, topography and ecology); and a *forward connection* in which the design considerations include an anticipation of the likely future historical consequences of the building. Each of these particular connections result from a number of influences and factors.

The emergence of regionalism in contemporary architectural debate originated in part from the culmination of changes in recent years in the climate of architectural opinion concurrent with the growing doubts that the earlier assurance of the Modern Movement in architecture had been justified. Twentieth century architecture has been mainly about functionalism, rationalism, standardisation and economy — all the things that make life tedious and oppressive. Those elements consistent with art and culture such as ambiguity, inversion, humour, sensuality and ritual — all the ingredients that make life interesting appear to be missing. The emergence occurs at a time when the architects of the Asian region have become increasingly aware of the importance of an architecture that is their own, which can authentically express their own goals and identities. There is a collective search for a locally relevant and contextual architecture.

The bulk of the developing countries in Asia lie along the tropical equatorial belt where further impetus followed from the impact of independence and post-colonialism. The sudden emergence of the sovereign nation brought about a spirit of assertion and increasing confidence. Accompanied by the wider reaction against the simplistic model of modernisation, this spirit generated a nationalistic persuit for an identity.

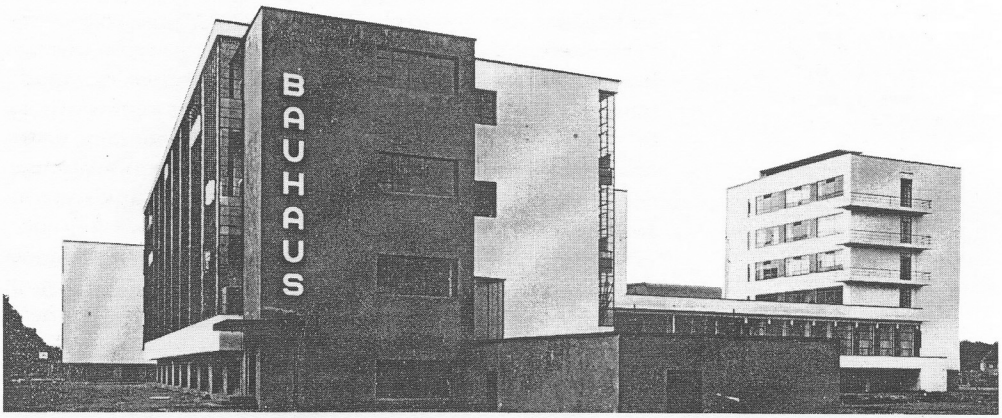
This search for a national identity became more urgent as these same nations along the tropical axis became, often inadvertently, more internationalised through economic development, media, world trade and the free exchange of capital, people, ideas, construction materials and universal building programmes. Inevitably, as the attendent processes of urban migration and urbanisation accelerated in many of these countries, the architecture in the built-up areas invariably became increasingly internationalised in design and in appearance, and in that same process submerged

The Impact of Modernism

The Modern movement had been taken to be a synonym for progress, that the country has arrived. It had been unfortunately perceived to mean that the antiquated urban fabric had to be made functional, and the way to do that was to wipe it out, start clean, and build unornamented towers as pristine objects on a plaza of concrete. The scale that constituted the tissue of urban street-life was destroyed.

Modern movement was designing out of the Asian city, the elements of 'Asianess' that include climatically responsive five-foot ways, intimate streetscape, traditional trades, memorable places that result from the natural history of the place, corners, and facades.

The arguement is to provide an urban environment that embodies a sense of continuity, and place. Regionalist architecture seeks to its architectural significance through relating built configuration, aesthetics, organisation, and technical assembly to a time and place.



important local regional and often national characteristics. However, it also became apparent to the local community that their human needs, their social systems and cultures are not readily interchangeable internationally, and that their built environment, instead of becoming more similar, should in effect encourage and facilitate the emergence of those local and regional differences and their unique characteristics.

Asia covers a vast mosaic of different communities in which each is confronted by a number of conflicting problems, such as extremes in poverty and wealth, conflicting differences in habitable terrain and climate, in the increasing speed and content of the process of change and modernisation, and others. There are multiple tendencies in each society within the Asia region each with its own different set of priorities. For instances, some focus on increased economic development, some on rapid urbanisation, some on housing the population. In some, political problems seem to override the others.

Regardless of the various national priorities, the common absence of adequate theoretical bases for a regional architecture, especially for urban conditions, remains an urgent issue requiring resolution. This question acquires an increasing level of urgency in Asian urban environments since their compactness and high concentrations of population are more socially and environmentally intensive than in rural conditions.

Unfortunately the processes of urban growth and development do not wait for the appropriate theory to arrive before proceeding. Building activity has its own motivation. As the problem of the increasing internationalism of the Asian urban environment becomes more apparent, we suddenly find that a number of our Asian cities begin to have a banal similarity, especially in those where a similar process at a similar pace has taken place, such as in Kuala Lumpur and in Singapore. By the time concerned architects and the administrative community of those countries awake to the need for a critical rethink and redesign, the urban situation may well be too extensive to remedy. Furthermore, the opportunities to create the urban environment that we want which can be afforded by an advantageous economic cycle for rapid development may also have lapsed. Then the local community may need to wait for the next economic cycle before any remedial action can effectively take place.

Of course one argument might be to say that the real cause of the problem is simply one of cities and of urbanisation. Then all we have to do is revert back to or maintain the traditional village or rural structure in Asia, and whatever concern that we might have for the need for a responsive contextual urban environment would not arise. However, sizeable cities have always existed in

history, for instance along important trade routes such as the case of Dhaka. Asian cities are not twentieth century inventions. Besides, we do not have a *tabla rasa* in our Asian environment to change in entirety the existing urban fabric and infrastructure into a decentralised village ideal.

The existence of the present extensive social and economic problems in many of the countries, the existent demographic concentrations and pattern of settlements, the disposition of the built-up area and infrastructure that have been invested, the economic function of cities in the developing country, the need for these nations to generate income and national development, and a host of other factors, all work as counter arguments against this anti-urban proposition.

It might be held that urban growth and cities also do not necessarily lead to conflicts. Even in some of the poorer countries in Asia, there are cities of significant size, and the continued existence of these cities is held by their governments to be vital. Presently, about 35% of the Asian population are already concentrated in the cities and urban areas. Inevitably, the growth of these cities, towns and other urban centres need to be controlled, planned for, and their buildings need to be designed and require immediate attention. In a situation where we do not have adequate independent theoretical bases for their design and where rapid design responses have to be made, the tendency might obviously be to use that which is expedient — current imported Western models and concepts of aesthetics. The need for the theoretical bases for regionalism therefore requires urgent attention and redress.

The contemporary urban building when it reaches a certain scale becomes an high-technology item. It uses up a significant amount of material and energy resources for its production and requires sizeable and elaborate systems to power and to maintain. As an archetype, the high-rise building arises out of the economic and physical needs for intensive development on restricted urban sites. It might be argued that the intensively developed situation might be avoided. This often works against existing market forces and the existing disposition of infrastructure and land use.

The high-rise urban building, like the Boeing 747, might be described as a complex and intricate modern piece of international machinery. In comparison with the airline industry, we would find that many of the nations in Asia including some of the lesser developed ones have considered it a national necessity to have their own international airlines whether for reasons of tourism, trade or for geographical accessibility. Furthermore, many operate them competitively worldwide and successfully. Despite the contemporary technology, many are able to incorporate a distinctive ethnic national identity to the airline besides possessing

certain common Asian hallmarks such as hospitality and informality. In instances where it is effective, the result arises from the successful *localisation* of this high performance piece of modern technology.

The results give important indicators towards the regionalist design of other comparable high technology items such as the high-rise building type. In the same way that the modern aircraft is not negated, the use of modern technology as such should not be rejected in the Asian built environment simply because it is imported and contemporary. Our efforts at regionalism have to be technically selective. The design question lies not in negating imported and modern technology, but in seeking ways in which the contemporary technology and ideas can be beneficially localised to meet the real needs of the community.

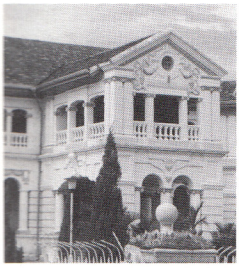
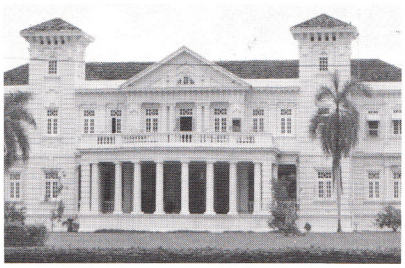
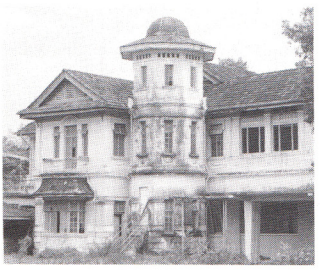
In seeking to incorporate the spirit of the place, the regionalist architecture would seek by design to structure a continuity with the past that includes the cultural tradition and the architectural heritage and vernacular of the place. This linkage can be both a *direct* as well as an indirect or *abstract* linkage.

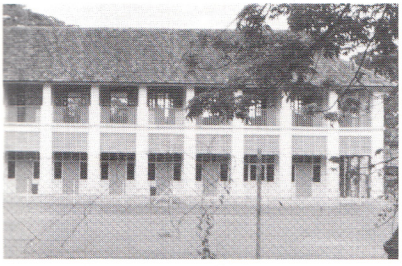
While recognising the need for a continuity with the tradition of a place, tradition itself should not be held as constituting an immutably fixed set of devices and images, but rather as consisting of superimposed layers of inventions. For there lies underneath the architectural heritage and vernacular of a place an important heritage of ideas. The designer's task lie in being able to uncover and identify that collective heritage of ideas of the place that includes both the traditional and contemporary forms, patterns and principles for dealing with architectural design issues such as climate, use of local materials and forms of assembly, geography and ecology, spatial organisation and culture, etc. We would need to unravel those layers to see how the indigenous archetypes can be subsequently transformed into contemporary forms and use.

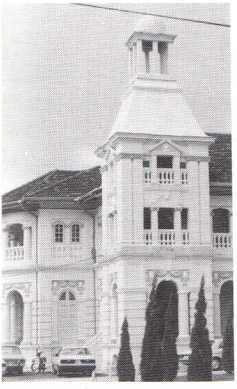
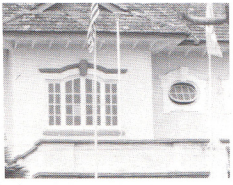
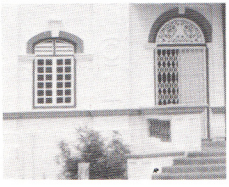
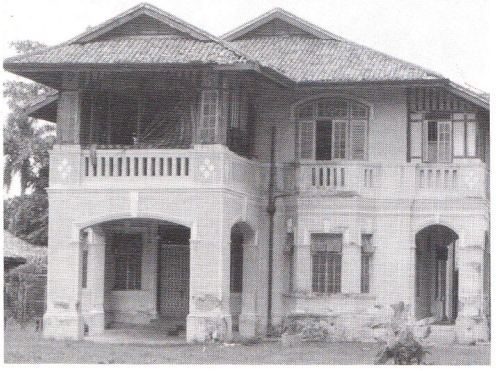
Searching the Past for Ideas and Inventions
The designer's task include investigative analysis of the heritage for devices and principles that can be creatively adapted.
For instance, Penang has a rich heritage of types that include mansions and institutional buildings set back from shaded avenues. Architectural devices include: multi-use porches, verandahways surrounding living areas, raised ventilated timber floors on piers, pitched roofs with gable ventilators, balustraded terraces on upper floors, moveable louvred doors and roll-up blinds, louvred sun-shades.

A direct link between the technology of building and the cultural tradition of the place can be made through the creative development and adaptation by the designer of the built forms, devices and aesthetics that are uncovered through an analysis of the architectural heritage and vernacular of the place. In the Malaysian architectural heritage, these include, for instance, such forms and devices as the verandahway, porch, collonaded walkway, balcony, ventilator-roof, gable-ventilator, and others found in the vernacular that could be creatively adapted.

A direct linkage does not mean a literal linkage. For instance, the built form of the timber house on stilts with the steep thatched-roof is a common heritage of many of the countries in Southeast Asia (e.g. in Malaysia, Indonesia, Philippines). This image has

provided a popular model as to what the Asian architecture should look like: the low-rise structure of indigenous construction. Notably, this is largely a rustic ideal. Where timber plays a predominant role in the construction and to meet contemporary standards of wear and tear would require treatment such as 'tanalising'.

While the form has been adapted inventively to many contemporary rural conditions which are the same conditions from which the form originated, the form as it is cannot be always nor readily adaptable to contemporary urban conditions. In the urban context, instant regionalism can of course be achieved by the literal tacking-on externally of cliche forms taken from the vernacular to a modern high-rise building configuration.

The Timber House Heritage

Below: The timber house on stilts with the steep thatched roof.

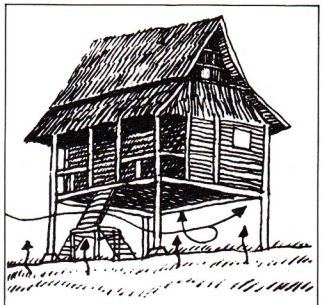
Right, below: The Malay Kampong dwelling.

Right, bottom: The modern pastiche.

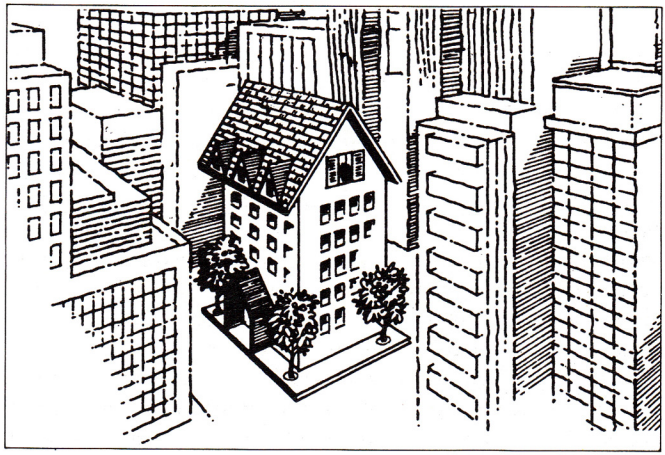
The house on stilts with thatched roof is a common heritage of many in South-east Asia (e.g. Indonesia, Philippines, Malaysia). This archetype provided ready imagery effective in low and medium-rise structures.

The Malaysian type, originated from rural setting. In similar settings its contemporary adaptation appear satisfactory. The form encounters difficulty in the intensive urban context.

The expedient regionalist response had been to create pastiche by adding a pitched-roof to the high-rise configuration. The legitimacy becomes questionable. Short of the superficial appearance of the planted forms, the building may appear Asian initially but remains fundamentally alien.



The raised stilts, serambi, and one-half inch slatted floor gaps of the Malay kampong house provide for ventilation, shade, and protection from ground moisture, flood water, and animals.

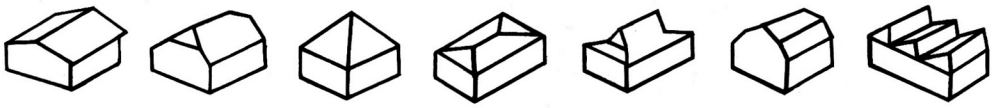


Style as an additive
An example of the pastiche approach is this rampant additive of Thai historical features of curved eaves, tiered roofs, and domed spires complete with sailing junks over the British Houses of Parliament, London Bridge and the River Thames: the Asian architect's revenge.

Such stereotypes are generally created for the unknowing tourist to fulfill their preconceived images of Asia. Unfortunately, the local community itself often becomes susceptible to such stereotype, particularly the well-intending conservationist for whom regionalism can be sentimentally identified with the vernacular. In situations where an admiration for the vernacular enforces a doctrinaire application of a limited set of forms, images and devices to all programmes, the result can be a regressive, tedious and unthinking traditionalism. The superficiality of the instant regionalist solution works against authenticity. In many instances, the building may look local on the outside but is essentially a Western building.

The process of adapting a traditional form for contemporary use requires inventive transformations. The design effort is not a literal transposition of one form on to another. One of the strongest justifications against the literal and simplistic adoption of the vernacular is that the earlier cultural, economic and physical conditions which have determined that vernacular style now no longer exist. In present day conditions, the range of building materials and the latest in building technologies can be imported from anywhere with economics being the main limitation. As local economic and physical infrastructural conditions and natural landscape conditions may not be the same, the literal adoption of vernacular becomes anarchronistic. The approach calls for a critical, inventive and creative transformation of the traditional built forms, devices, aesthetics and images derived from the past to suit contemporary conditions and requirements.

Regionalist design can also develop through an *indirect* or *abstract* link with the endemic qualities of the place. This indirect connection involves the contemporary design interpretation



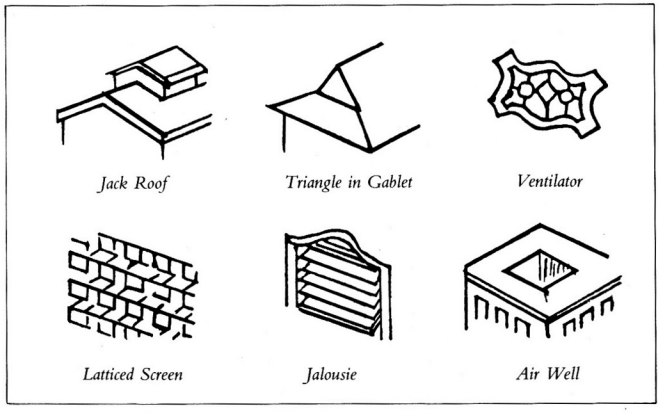
Gable *Hipped Gable* *Pyramidal* *Hipped* *Gabled Hip* *Mansard* *Sawtooth*

The Systematic Analysis and Survey of the Heritage

Above: A classification of roof forms in the Malaysian architectural heritage.
Right: Methods of ventilation.
Below: Transitional areas.
An example of an organised approach to understanding the principles, forms, spaces and technology in a country's architectural heritage through a systematic survey (Badan Warisan Malaysia).

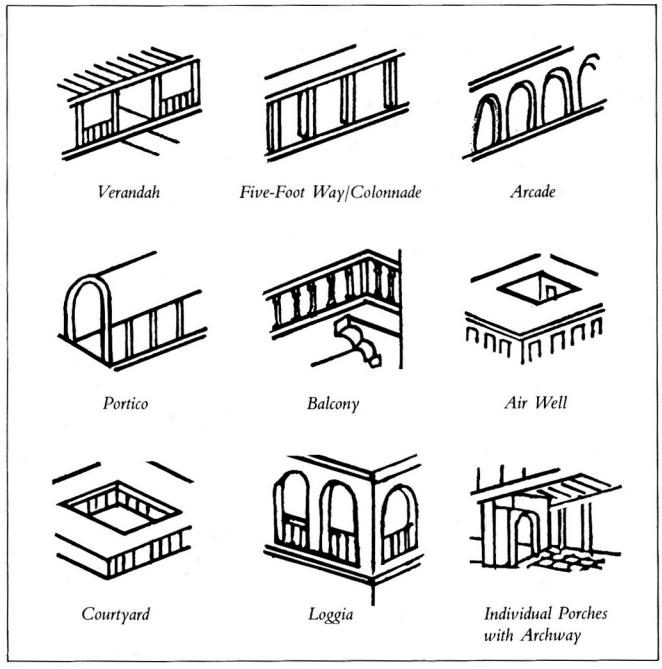
Far right: The Malaysian Architectural Heritage

Despite a brief history of nation-building, the Malaysian architectural heritage as a consequence of its trading and immigrant influx contains a rich and complex multi-symbolic, cultural and religious context within the umbrella of a predominantly Islamic priority. Without a systematic survey and analysis, the heritage's usefulness to contemporary society remains untapped.



Jack Roof *Triangle in Gablet* *Ventilator*

Latticed Screen *Jalousie* *Air Well*

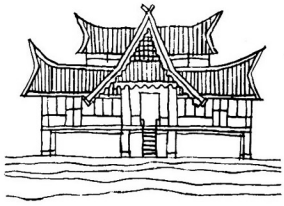


Verandah *Five-Foot Way/Colonnade* *Arcade*

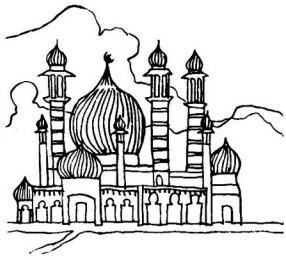
Portico *Balcony* *Air Well*

Courtyard *Loggia* *Individual Porches with Archway*

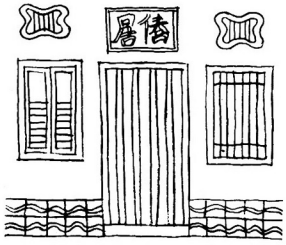
Monitor *Vaulted/Arched* *Minangkabau* *Meru 3-tiered* *Domed* *Gable with Airwell(s)* *Gable with Jack Roof*



The Malay Palace (Istana)
A Malay house with steeply pitched roof, deep overhangs, raised on stilts and entered by a ladder and sometimes masonry steps. Materials, like atap, bamboo, rattan, and timber are readily available from the luxuriant tropical jungle.

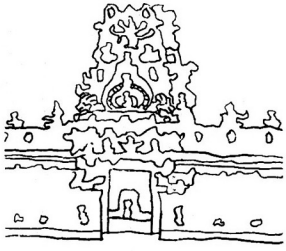


The Mosque
An example of a mosque with onion-shaped domes and minarets, inspired by mosques in India and the Middle-East. They are orientated to face Mecca, as required by the Islamic religion.



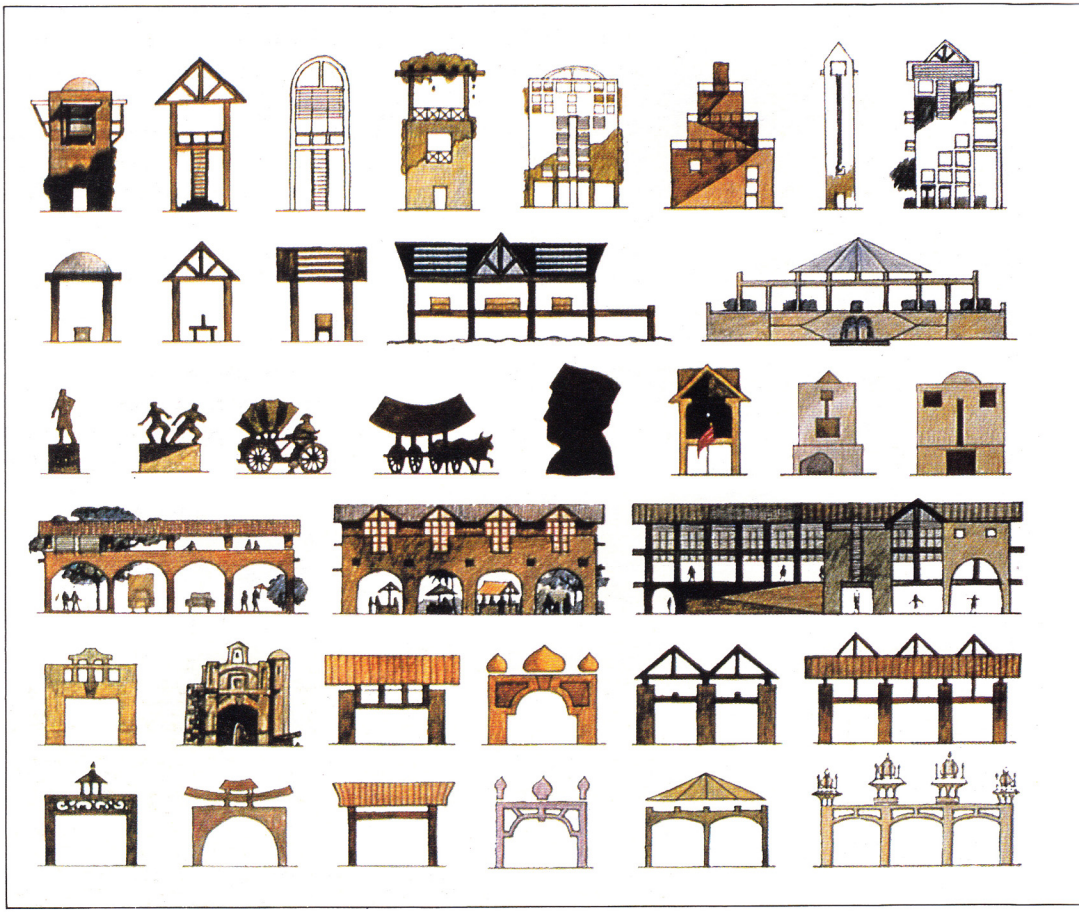
The Chinese Shophouse
Street-level porch area of a terrace house with timber bars locked into the door head, windows with metal bars and louvred panels, ventilation openings and glazed wall tiles.

The Chinese Temple
A typical Chinese temple with curved overhanging eaves and adorned ridge, lattern, etc, apart from other symbolic ornamentations.



The Indian Temple
The entrance to an Indian temple where the various statues of deities and goddesses are arranged in a rich sculptural form of multiple colours.

The European Church
A typical example of a cathedral church with religions emblems, stained glass and louvred windows, arches, etc; all designed around a cross-plan.



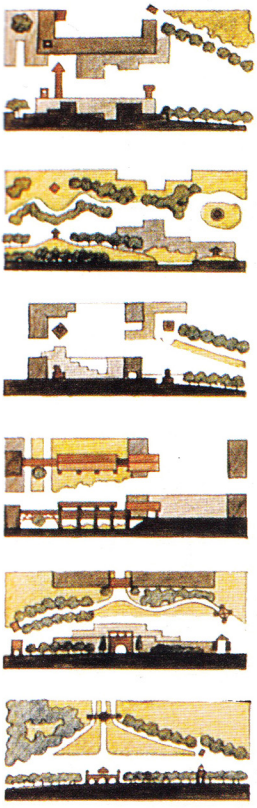
Street Arches and Pedestrian Cross-overs
Symbolism provides a route to creating an identifiable environment. Instant symbolism can be conjured through ceremonial arches and monuments. Often these ephemeral structures for festive days may easily be abused as political devices, their positive use enhance the mood of the place as in a celebration. However, they do not constitute the entire environment and are piecemeal in the social and economic functioning of the city.

from *general principles and lessons*, not from physical forms, devices and images. These are the general principles and lessons which can be identified through the analyses of the cultural tradition and architectural heritage of the place. The regionalist approach seeks to look beneath the surface to uncover the basics that can be transformed for contemporary use. These analyses should penetrate to those generating principles and symbolic substructures of the past to enable the designer to transform these into forms that are right for the changing order of the present.

For instance some of the important features of the traditional Chinese shophouse design in Malaysia are the continuous covered verandahway and the various methods used in that building type to minimise the discomfort of the tropical climate. These include the use of an internal air-well court which allows light, natural draft and openess in the interior spaces without letting in the full

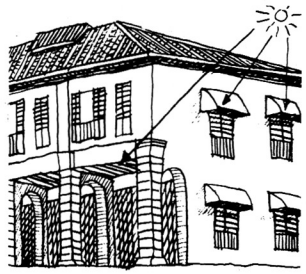
heat of the sun; the use of high ceilings that encourages a natural draft; the use of overlapping-roofs which cools the heated roof and reduces the radiation that would otherwise transmit to the rooms below; the inclusion of vents built into the wall below the roof eaves to give natural draft; the use of high and low windows to give selective openings; screen and lattice work; ceiling vents to accelerate heat transfer, and others. The general principles behind these devices remain valid and can be creatively interpreted to meet contemporary intensive urban situations.

Besides such analyses of the traditional technics of construction, their devices and images, the regionalist approach also requires a sensing beneath the surface of those memories, myths and aspirations of the place that give the society coherence and energy. Beyond the particular, the regionalist must see the type, the general rule, the originating principle. These provide the conceptual generators for design. The rural vernacular of a place for

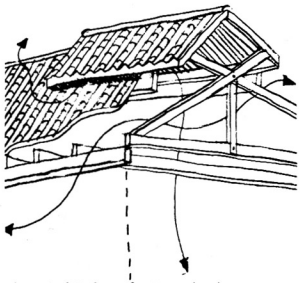


The Internal Airwell
Right, above: The internal courtyard.
Right: Spaces facing the internal courtyard.
Example of transitional space is the courtyard. These serve functions of ventilation and daylight. Space itself is multi-function e.g. parties, playspace, worker's dining, drying food-stuff, rituals, etc.

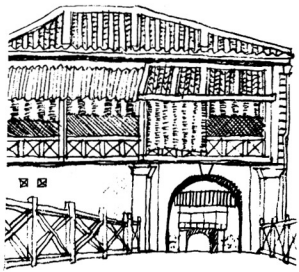
High pitch roofs, large overhanging eaves, wide shaded verandahs at the ground and upper floors of a colonial bungalow, gives protection from the sun and rain.



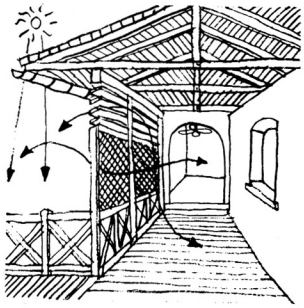
Traditional shophouses with jack-roofs, louvred doors, covered verandahways, canopies, etc; offer protection and shade from the heat and rain.



A typical jack-roof over a shophouse. This elevated gabled roof segment, shelters a clerestory opening which separates it from the main roof, enhancing cross-ventilation effects to reduce heat.

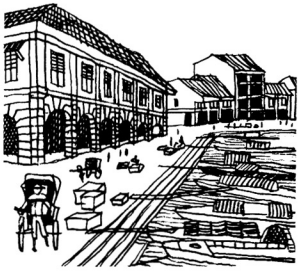


A typical colonial house with cheek blinds over shaded verandahs, porch, air vents, etc; to facilitate cooling effects by encouraging cross-ventilation.

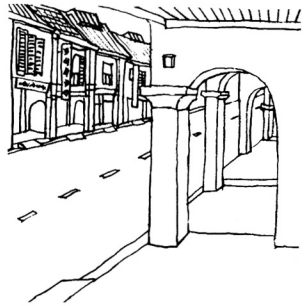


Deep roof overhangs, ventilation grilles at high levels, geometrically patterned grilles for sun-shading, fans, etc, all add to a tropical response to the warm-humid climate.

The rowhouses of Malacca have covered walkway linkages dating back to the 18th century, during the Dutch occupation. They were both used as warehouses and for residences.

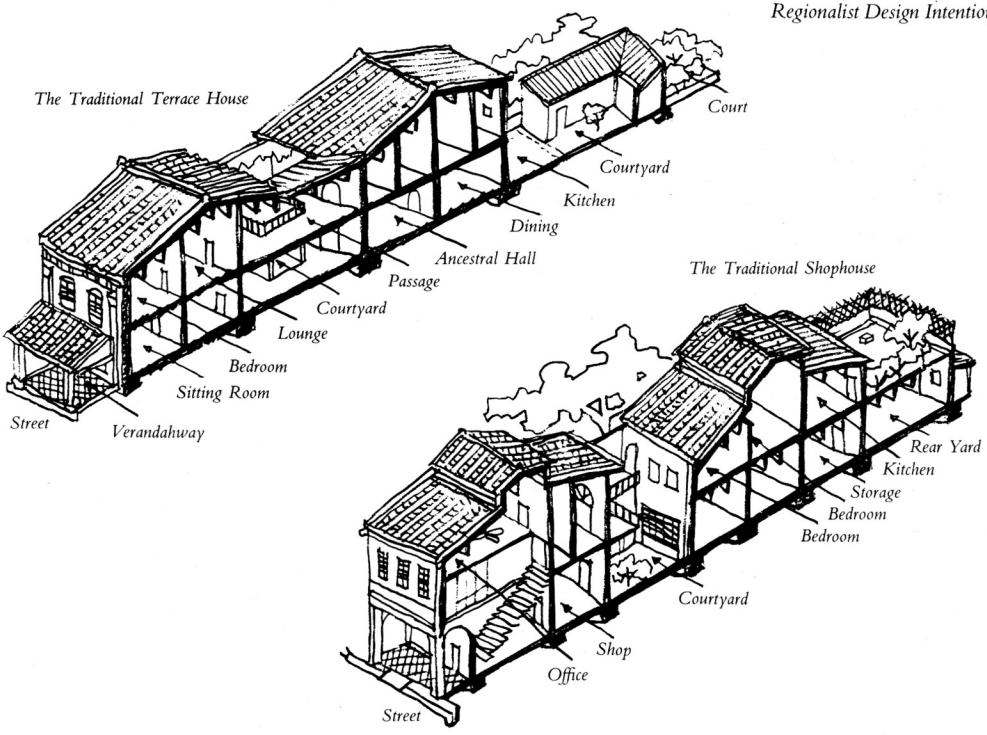


The shophouses along the River are marked by a relatively uniform facade. These warehouses have a continuous covered verandahway along their uniform length. Tongkangs and small lighters form a picturesque scene.



The traditional terraced shophouses form the basic component of the urban fabric of Malaysian cities.
They are characterised by a 5ft pedestrian colonnade which offers protection from the sun and rain.

Later types of shophouses became three storey and higher retaining the traditional continuous rhythm of the verandahways at street level. These early 20th century examples display a multiple of eclectic influences in the detailing and decor.

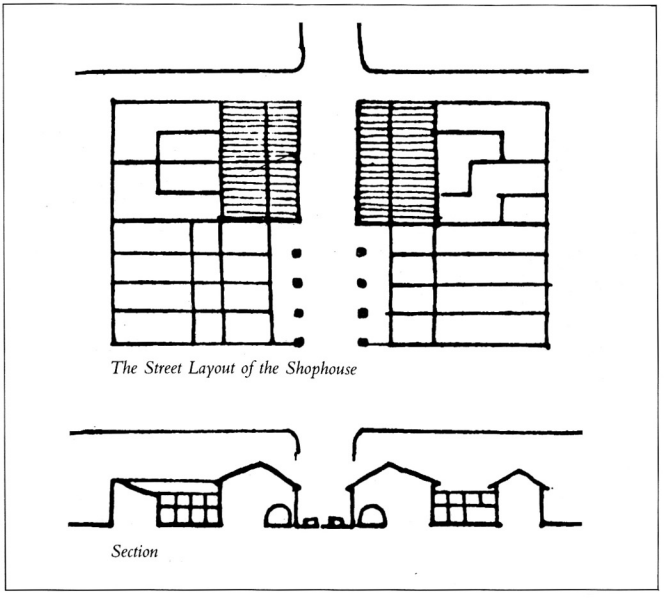


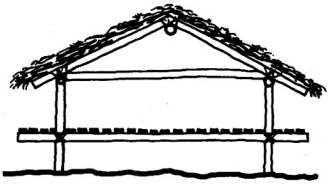
Left: Traditional Responses to Climate

Culture in architecture results from a group's response to its environment and the fulfilment of its spiritual and physical requirements. Regionalist architecture is not a style; it is a way of life where various facets of that society and solutions to its problems are reflected in the architecture. A direct link with the culture of the place can be made through the adaptation of the traditional responses to climate and creatively using these to solve contemporary problems.

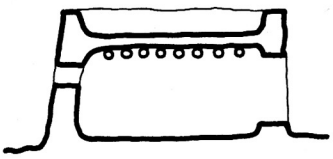
Above and right: The Shophouse Archetype

The traditional Chinese shophouse is an important urban archetype in the early Malaysian town. Understanding its spatial morphology provides ideas for contemporary use in making the Asian city identifiable.





Tropical Rainy
Roofs more important than walls (which may be omitted); timber frames with leaves, branches; wide eaves.

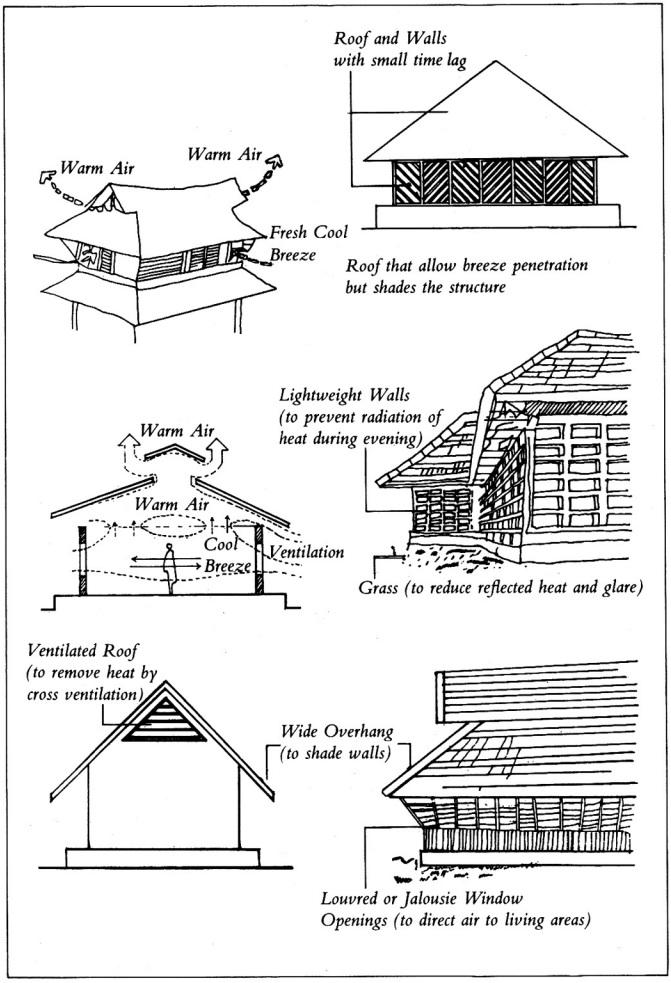


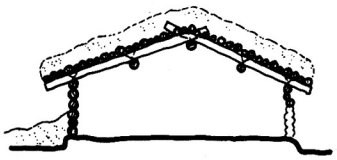
Hot Dry
Walls more important than roofs; often earth roof on stone or clay walls.

Warm Temperate
Adobe with thatched roofs, or tents of felt or skins.

Above: The Traditional Regional Dwelling Type
Climate has historically been one of the major determinants of the form of the vernacular.

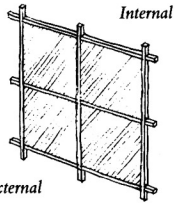
Right: Vernacular Architectural Features for Thermal Control



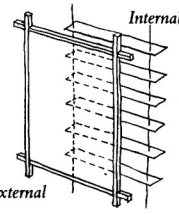


Cold Snow Forest
Heavy timber construction. Low pitched shingle or log roofs to allow snow to lie as insulator against chilling wind.

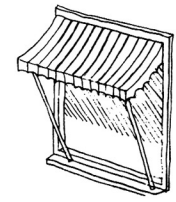
Methods of Solar Shading of Windows
The task of filtering daylight in tropical climates are: firstly, to provide adequate daylight even if windows are protected by louvres or grilles for thermal reasons; secondly to exclude from the visual field excessive bright surfaces, which would cause glare.



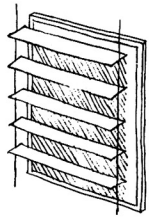
a. Tinted glass or applied reflective surface offers protection in any orientation but has thermal problems associated with accompanying exterior dazzle from the reflective films.



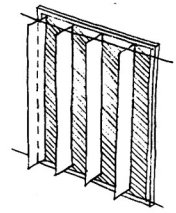
b. The easily installed internal louvres intercept energy but tend to act as convector heaters with little control once the energy has been allowed to penetrate the glass.



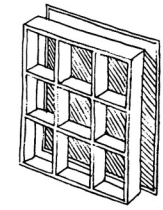
c. The traditional canvas shop blinds is simple but vulnerable to wind. Can be efficient when fitted with side cheeks but limited in use on multi-storey buildings.



d. Very efficient shading device from high-angle noon day sun can be fixed, movable, slatted or solid to promote ventilation. To reduce conduction of solar heat, preferably mounted clear of the building.



e. Efficient shading from low-angle sun in the morning and evening but with difficulty of protection on windows facing the east or west. Where solar impact is excessive use movable complete shutters.



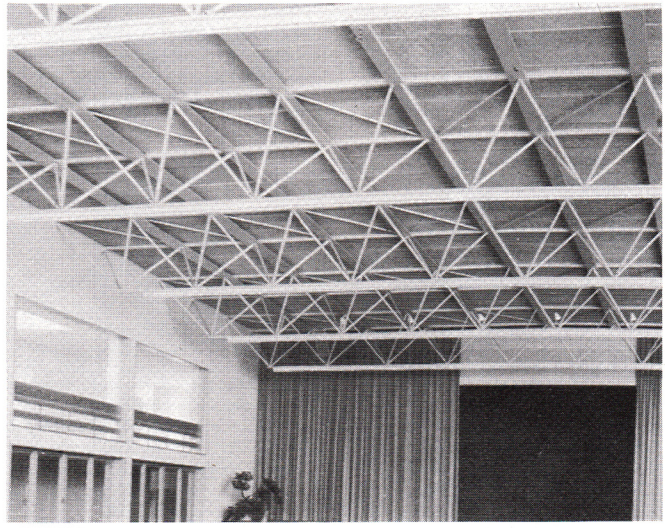
f. The combination of (d) and (e) results in a group of smaller windows with deep reveals to provide for a better cut-off. Fixed fins can offer a separate structure from the building proper.

instance, offers numerous lessons in ways of dealing with climate, and these can be translated into quite different functions with modern technologies. The traditional forms of construction, materials and craftsmanship of the artisans provides further sources for deriving principles and sources of assembly and ornamentation for adaptive reuse. The traditional monuments in the heritage should not be read just for their superficialities of style, but for the

deeper lessons of order. The existing fabric of the city may yield many concepts and metaphors for handling open and transitional spaces.

Clearly, the regionalist design approach must also inclusively accept the realities of the present. Whether the designer may like it or not, all new construction takes place in the present where contemporary influences, technology, context, world trade and economy, all of which are already there in the present and have to be contended with. Rather than negating contemporary ideas and forms of construction, the design question to the regionalist is therefore to seek *ways in which the imported technologies, materials, ideas and built forms can be effectively localised* (where appropriate) to best fulfill the building, the programme and be beneficial to the local community.

In the same way that the cultural and architectural heritages of a place need to be analysed for their built forms, devices, images, principles and ideas for adaptive contemporary reuse, a similar analysis should be carried out for present-day imported ideas and technologies. The process lies in finding that which is universal and not simply international in the best of contemporary archi-



Right: Contemporary Construction Technology
In the regionalist design approach; contemporary construction technology, ideas and forms need not be negated but need to be localised.

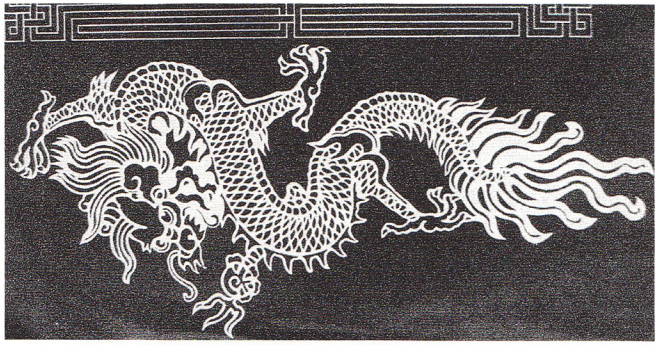
Below: The Yin-Yang Symbol
The Yin-Yang provides a model describing regionalist design: to fuse in unity (circle) conflicting aspects and polarities (segments) while permitting dynamic interaction (rotating pattern) an acceptance of complexities (alternate coloured spots within segments).

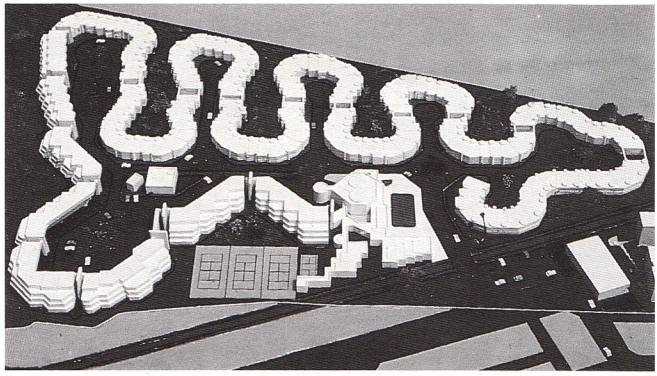
tecture and then combining these with the regional codings and sensibilities.

The process of design requires the making of appropriate and critical connections between modern imported technology and ideas with the indigenous aspects of the place. The approach should seek to fuse the old with the new, the regional with the universal. Analogous to the Chinese Ying-Yang symbol, the

fusion of polarities should seek unity, and within this a dynamic interaction and an acceptance of complexities. More important, the design has also to relate to the present real culture and social needs of the people and must involve an understanding of the contemporary spatial modalities of the people, the way they work now, the way the culture arranges privacy and community. The present must be recognised. It would be pointless to design a built configuration that served an earlier culture and lifestyle which is currently non-existent and irrelevant.

The regionalist design approach should also recognise the uniqueness of the landscape, ecology and *natural history* of the place. In the same way that regionalist design seeks a link with the cultural and architectural history of the place, it must also make a connection with its natural history. The design should be influenced by the characteristic physical and natural environmental features of the place and should reflect and integrate with its natural environment. These include the location's climate, landscape, topography, and vegetation, including its ecology.





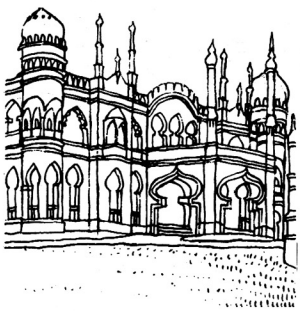
Direct Use of Symbolism
Left: The Dragon as Symbol
Left, below: Adapting the Dragon Form for Building Configuration
One way of making a direct link between building and culture of the place is to take a cultural symbol as a basis for design. The approach is simplistic and becomes irrelevant once initial correlation wears off. If symbolism is to be durable, then form must serve a systemic function in addition to symbolic i.e. the weaving configuration segregates pedestrian from vehicular and provides continuous consistent relationships between landscape and builtform.

The ecology of every location is clearly different and determines the character of its landscape. If through the process of rampant urbanisation the ecology of a place is denuded of its characteristic flora and fauna, we could well have effected an irreversible environmental loss. Although generally regarded as a function of climate, vegetation can in turn influence the local or site climate. Of the landscape components, climate is probably the most important influencing factor in the landscape.

Inevitably in the process of designing, the question will arise as to which symbols and images from the past should be selected. One historical layer can be arguably held to be as or more important as the next insofar as each has contributed to a country's heritage. Furthermore, much of the vernacular architectures are clearly not purist in origin but are hybrids of the indigenous combined with imported types, both of which would have experienced extensive changes over history. In Malaysia, for instance, those influences that have contributed to its building traditions include Malay, Southern Chinese, Sino-European, Anglo-Indian. If we were to take a bit from all of them unthinkingly, we would only produce an assemblage of disparate parts which in isolation are justifiable but inappropriate when placed in context.

In the regionalist design approach, the question of the delineation of regional boundaries will also arise. How does one define

The Malay Rural Vernacular
A typical Malay vernacular house of atap roof, timber panelling, raised above the ground level, provides an atmosphere of tranquility in the rural setting.



The Moorish-Influenced Institutional Building
The Istanas of the Malay Sultanate are grander in scale and are often of masonry construction occasionally with European and Middle Eastern influences.

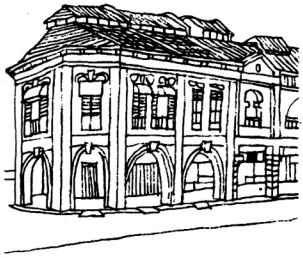
Dutch Influences
The most notable examples of Dutch influences can be seen in the Christ-Church and Stadthuys building in Malacca.

a region? Would it be, for instance, in terms of climate or cultural significance? If cultural inheritance is held as the criteria, then individual decisions would have to be made as to which cultures are to be considered in, for example, a post-colonial nation state. This notion of what constitutes a region's boundaries and references is furthermore not exact. It may refer to the distribution of racial or ethnic groups, to common geographical or climatic features, to political boundaries delimiting a tribe or some federation. It might not in all situations make sense to make a direct equation between region and nation and between region and religion. Nevertheless, any design process requires that choices have to be made.

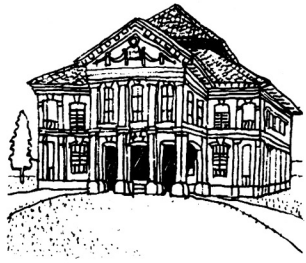
The fact that boundary definition is indeterminate does not invalidate the concept of architectural regionalism, but recognises that choices have to be made and that there are potential options for interpretation. We cannot and should not insist on a single specific form of regional architecture or style that is a set of built configurations applicable for all time and for all site conditions even within close proximity.

Architectural regionalism cannot therefore be held as a set style, but rather as an *approach* with specific intentions in which the end-product is didactic. The regionalist design in countries, for instance, which are geographically next to each other such as

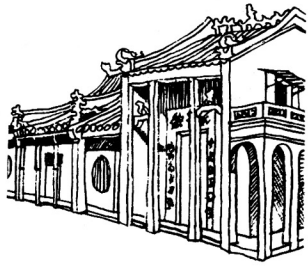
The Malaysian Building Archetypes



The Straits Eclectic
The Straits Eclectic style can be seen in the traditional Chinese shophouses. This hybrid compradoric style often shows the opulence of ornamentation in their facade treatment.



The Anglo-Indian Influences
The local Anglo Indian style has an eclectic blend of Palladian motifs, with Sino-Malay influences in terms of unglazed half-around tiles and the serambi, which is sometimes eliminated in its use.



Chinese Clan and Association Building
A clan temple built and used by many Chinese associations for ceremonial and social functions, with varied designs in terms of ornamentation and built form.

Malaysia, Singapore and Indonesia cannot be the same. The designer has to draw his own geographical, historical and cultural boundaries in relation to the building programme that he deems relevant to the programme and place. Clearly however, he has to operate at a design level that is much deeper than superficial stylistic or ornamental adornment, and his design has also to recognise that likely changes in culture and technology might take place over time. By definition, since regionalism is committed to finding unique responses to a particular place and time, it therefore cannot be *monolithic*.

The existence of architectural design variances and development even within the same locality becomes one of its characteristics, in that the forms and the aesthetics of a regional architecture will differ depending on that place and period. This of course does not deny the importance of contextual consistency where pertinent. The idea of a regional architecture cannot and should not be defined with finality in time or in character for a particular place nor be represented by a fixed set of images and styles. There should not be any rigid dogma or formula, and the quest should be permissive of a wide variety of viewpoints. Each region has to be seen in its own terms and period.

In the same way that regionalist design seeks a continuity with the past, the design must involve a *forward* aspect as well. The designer must anticipate the likely impacts that the design will have on the future environment of that place and their historical consequences on that urban context and society. This is the forward connection that the regionalist design has to make.

In synthesising the various regionalist intentions into a single design, the architect has to act upon and select from an enormous pool of sources that include the heritage of ideas, forms and principles, as well as from the ideas and technologies of the present, and make a relevant connection between them. In the design process, the designer has to make choices. A critical approach is essential in that he has to assess and test whether the patterns, forms, devices, images and technologies that he has chosen to interpret the design programme (whether they are invented or derived from traditional or contemporary sources) are right for the job. Ultimately the approach must transcend the superficiality of the aesthetics of building alone.

The criteria for making the appropriate choices might be for the designer to view the role of design itself as one of problem-solving, that the regional architecture must authentically seek to solve and respond to specific real problems vital to the society of that place, whether through the fulfillment of the design programme itself where the programme itself directly relates to the problems, or indirectly as consequences of the design. The

question of the design's authenticity depends in part on the extent to which it solves some of these real problems.

These intentions form the fundamental bases for architectural regionalism. Each set of connections to be made in design, whether direct, abstract, technical, physical or anticipatory, must be potentially valid and interrelated. The design process requires that a critical, selective and evaluative process takes place. The range of options are of course numerous, and their optimisation depends on making the choices held to be best suited to the programme.

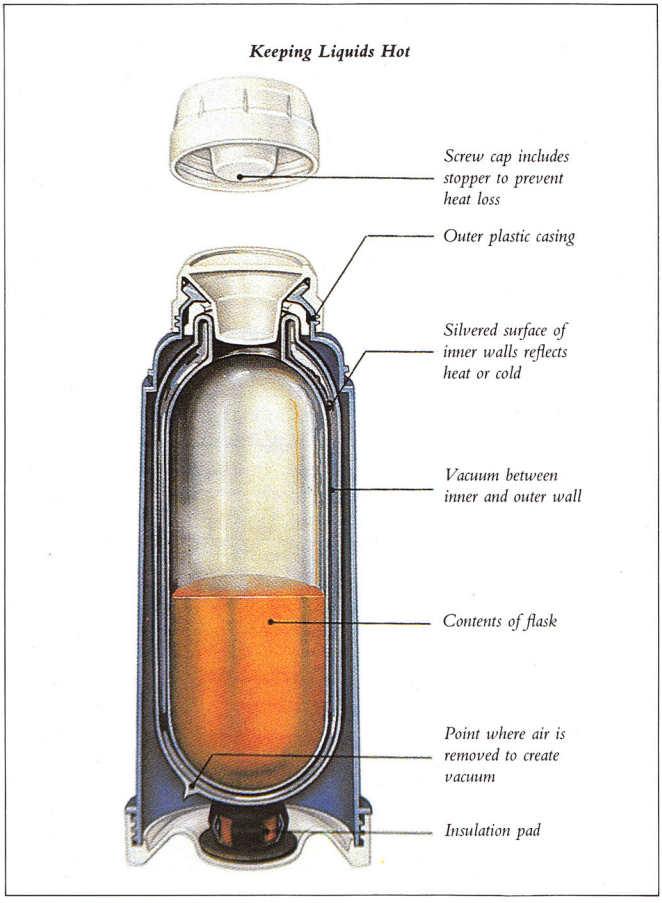
It must also be recognised that architectural regionalism is an evolving enquiry which has as its aim an authentic built environment. The situations and environmental context is dynamic, in that changes continuously take place. In order to avoid the prior assignment of a fixed style or the presumption of an inevitable set of preconceived forms and devices to a design programme, we might start from a systemic view of the attributes of the building enclosure that is independent of locational influences so that it can adequately serve as a general armature for regionalist design.

3 An Armature for Interpretations

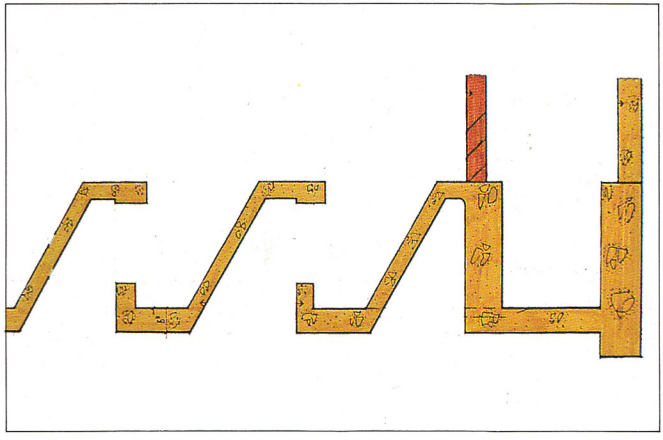
Current discourses on tropical architecture tend to place exceeding emphasis on schemes in usually rural and greenfield sites. Since many vernacular styles originated from such rural contexts, and since the intensive urban situation is comparatively new in Asia, it is generally easier to carry out regionalist design in rural locations. Those design efforts at evolving a regionally appropriate vocabulary in the urban context are often based on careful analyses of solar angles, wind movements and the thermal properties of materials, etc. and fail to produce an architecture which belong to the region. Often, the rigorousness of the climate performance analyses themselves further tend to inhibit the designer from any investigative deviation from the regular range of models. In many instances the solutions are simply *brise-soleils*, louvres and vernacular roofs added on as appendages to the inventory of 'modern' forms identified with the West. What is needed is an holistic concept that can permit the building enclosure itself to be perceived systemically without a prior fixation to a particular aesthetic, so as to enable a regionalist inventory of forms particular to a place and time to emerge.

A separate position might start from our examination of the systemic functions and attributes of the building enclosure itself and its relations it might have with the *climate of the place* being one of the dominant reasons for any enclosure in the first place. In effect, the building enclosure serves as a protective shelter for man from climate. In the development of the traditional shelter, it had been one of the key determinants of built form and construction. As a protective shelter, the building envelope serves as a mediator between man and nature and acts as an intermediary barrier between that which is enclosed (the inside environment) and the outside environment.

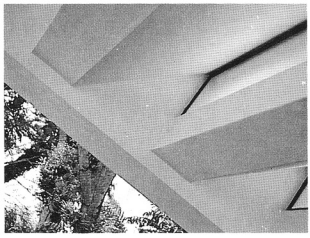
We might first draw an illustrative corollary between the climate of a place with the way its people dress, the way they build, the materials they use and the culture of that place. It becomes evident that our human society has several layers of enclosural intermediaries that separates it for various purposes from the natural environment. The most proximate enclosural layer is, of

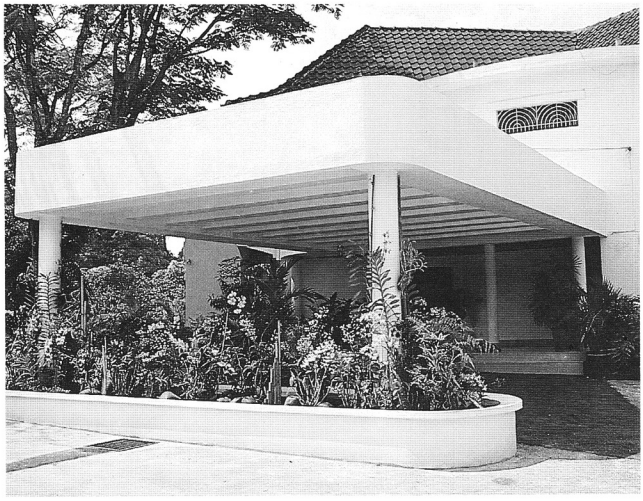


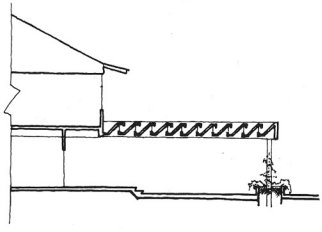
Left: The Thermos Flask Analogy
Differing viewpoints of buildings as systems: The building as analogous to a closed system*; the other to an* open system.
The closed system *is a direct analogy with the common kitchen thermos flask in which the function of the building enclosure is regarded as an insulative barrier where there are minimal or virtually no exchanges taking place between the natural environment and the internal environment within.*



The Sieve Analogy
Top: Louvred Sun-glasses.
Above: The Sieve.
Left: The Zee-profile roof as Sieve.
The antithesis is the open-system *in which the function of the enclosure is as a perforated barrier or an* environmental filter. *Filter acts as a* sieve *that enables selective exchanges between the external climate and internal spaces. Particularly in tropics where designing with climate is traditionally prevalent, the sieve analogy is more appropriate than the use of mechanical controls.*





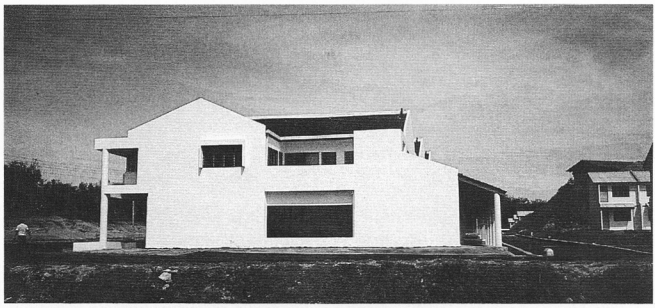


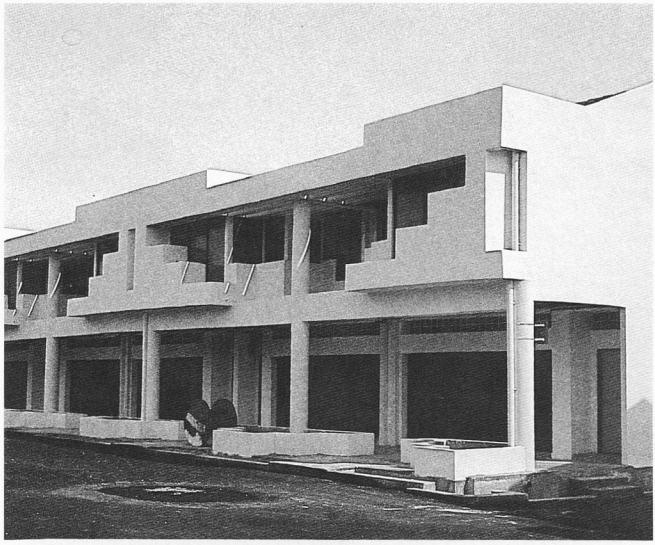
Zee-profile Roof with Glazing
Above, right: The zee-profile roof.
Top: Underside of porch.
Centre: Detail of zee-profile.
Above: Section of porch.
The mechanical actions of a filter are to keep out certain things and permit others through. One interpretation (inherent in the traditional vernacular), for contemporary programmes is the zee-profile section. In this the profile is designed with glazing in-between each section that sunlight is permitted in as diffused light but rainwater and vertical wind-flow is excluded.

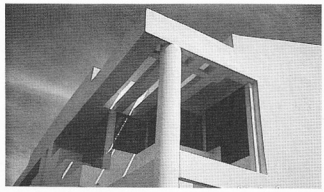
course, man's layer of garments, followed by his immediate built space and by the surrounding screens and buildings. Both his clothes and his architecture serve as different forms of protective envelopes. Their physical differences are in their functional requirements and lifespans of use.

We might observe that both also have cultural, ritual and symbolic identity-giving roles. In instances where a distinctive regional identity is clearly apparent in the garments, we are very likely to find that their form and aesthetics have been influenced significantly by the region's climate in determining the comfort level of the wearer; by the region's culture and mores in determining their range of styles and use; and by the local availability of materials, crafts and technology in determining their method of assembly and production. Notably, the non-ceremonial garments of the people of a place are generally good indicators of the climate of the locality as they have to relate directly to the wearer's comfort, his economic activity and his social status.

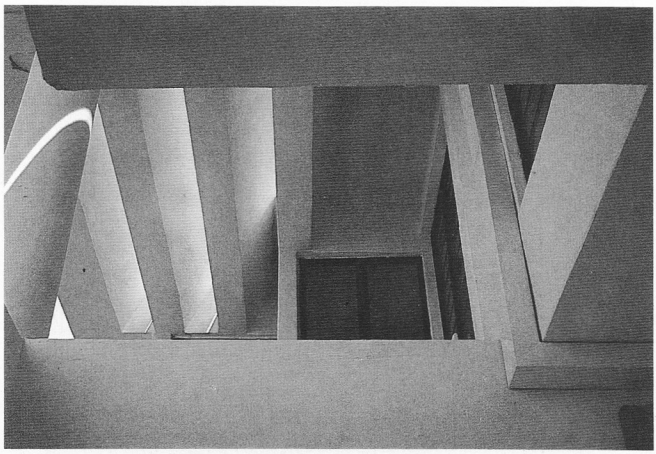
The vernacular architecture of a place can be an equally effective indicator of the locality's climate, culture and economic status. From this premise, an understanding of the relationship between the climate of the place and the enclosural systems provides an initial general armature for regionalist design intentions. Of all the endemic features of any locality, the singularly most consistent is likely to be climate (except for instances where total ecological depletion has taken place). Climate is generally consistent seen over, say, a period of a hundred years allowing for minor fluctuations in sunshine, rainfall, etc. when compared to other endemic aspects of the place such as culture and the built environment. It is also an







Filter Roof over Verandahway
Left, above: Shophouse with double-frontage
Left: Front verandahway
Left, below: Detail of filter roof over verandahway
Above: Corner detail
Over the verandahway, the zee-section is unglazed but each section located sufficiently close to give significant rain-water exclusion collected on a lower lip and drained sideways. Hot-air that would otherwise accumulate is permitted to escape through zee-section. It permits diffused light into walkway.



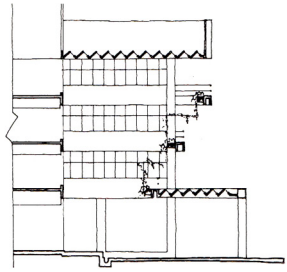
important influencing factor in the natural landscape.

The climate of a place results from the interaction of solar radiation with the atmosphere and gravitational forces, together with the distribution of land and sea masses that produce an almost infinite variety of conditions.

Certain zones and belts of approximately uniform climates can be distinguished. Boundaries of these climatic zones cannot be accurately mapped, as one zone merges gradually and almost inperceptibly into the next. It is nevertheless easy to identify the zone in the transitional area between two zones to the place in

The Traditional sun screen in the Moroccan Souk
The concept of a pergola roof over passageways is also found in the traditional use of reeds matting placed over the shopping stalls in this Souk in Marrakesh.

which a particular settlement belongs. Those aspects which affect human comfort and the design of enclosures include averages, changes and extremes of temperature, the temperature differences between day and night (diurnal range), humidity, sky conditions, incoming and outgoing radiation, rainfall and its distribution, air movements and special climatic features such as trade winds, thunderstorms, dust storms and hurricanes. The extent of climatic design issues vary with the zone. For instance, in the tropical hot-humid climatic zone where Kuala Lumpur is located, heat is the dominant problem, and the annual mean temperature is generally



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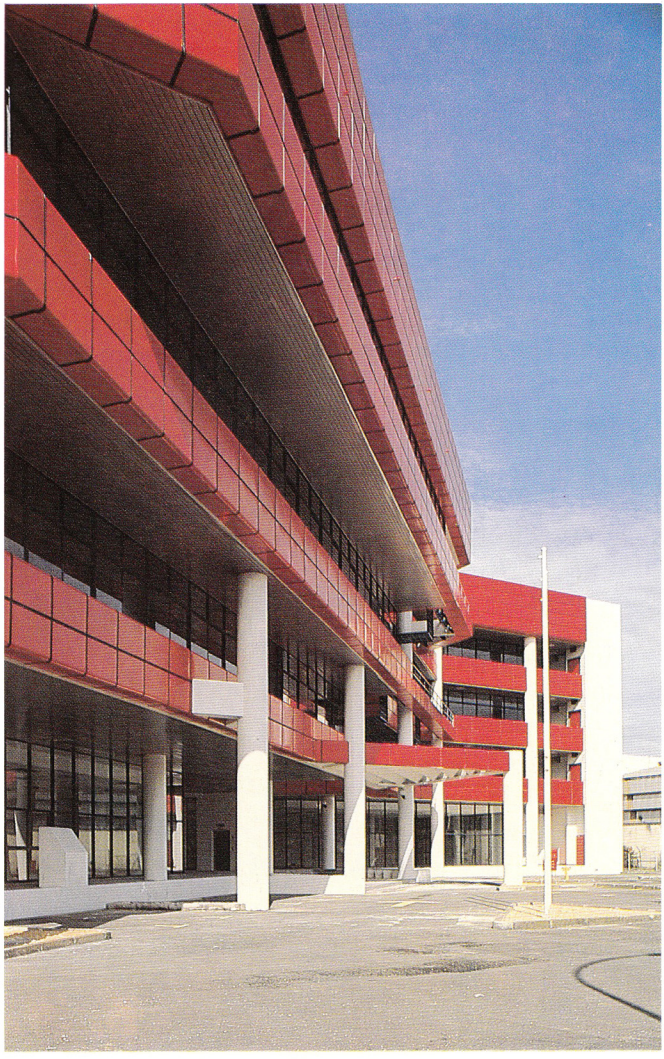


Composite Zee Roof and Spandrels
Left: The filter roof over the porch and lobby.
Above: Underside of lobby and layered spandrals.
The circulation areas treated as open to the outside spaces. A composite system of zee-sections, trellises and spandrels are used here to serve a number of functions: entrance canopy, upper level walkways, lift-lobby roof, planter-boxes.

not less than 20°C. This aspect influences the design of the contemporary building in that the enclosures have to keep the occupants cool rather than warm.

We might contend that the function of the building enclosure is as a protective device that serves to modify the outside climate in order to produce certain required indoor conditions for some activity (which itself may be either determinate or indeterminate). Buildings might be regarded as enclosural *systems*. Two differing viewpoints can be held. One regards the building as being analogous to a *closed system*; the other to an *open system*. These polarities do not, of course, rule out the acceptance of composite systems. Generally the two concepts of the building enclosure possess differing relationships and attitudes to the natural environment. One relies mainly on structural (passive) climatic controls, whereas the other relies more on mechanical (active) climate controls.

In the closed-system analogy, the function of the building enclosure is regarded as an insulative barrier in which there is either minimal or virtually no environmental exchange taking place between the natural environment on the outside and the environment within the enclosure. The internal environment has little or no dependence on the climate of the outside as for instance, in a space-craft. Of course, in reality a totally closed system would not exist except in classical thermodynamics since all systems in the biosphere eventually are dependent on the external environ-

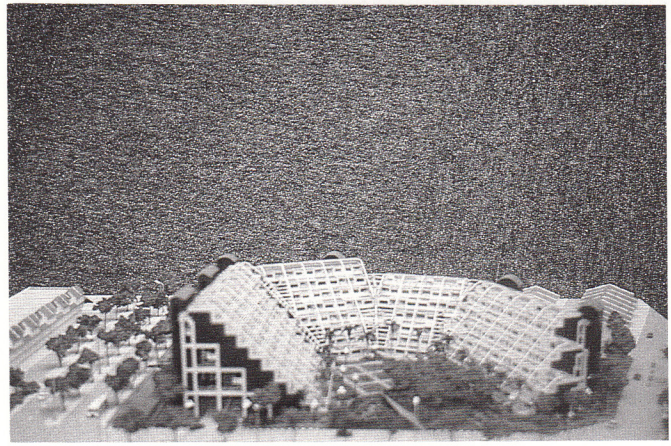
Composite Filter Louvred Roof with Tiles
The louvred roof profile need not be restricted to non-vernacular forms. A composite roof design is used here to combine a louvred (slatted) profile roof with the traditional vernacular pitched roof with tiles to provide ventilation and partial enclosure to the staircase circulation areas.

ment for some input or some output, even if it is only for heat loss from work. Based on the closed-system analogy, buildings would therefore be designed as almost totally insulated compartments containing a well-tempered climate in the internal environment. Their internal climate would be mechanically controlled, i.e. through airconditioning and artificial lighting.

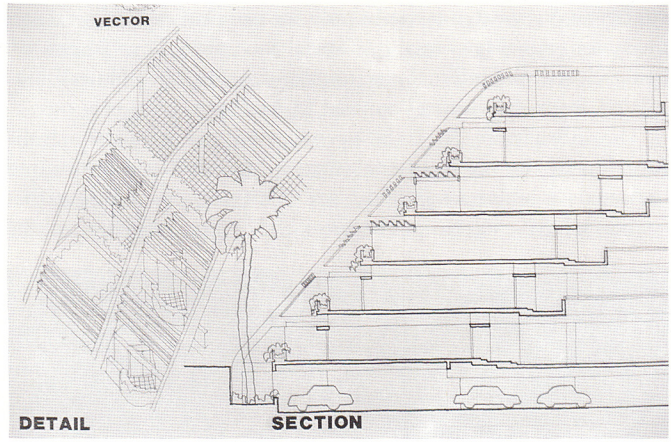
The closed-system design became possible with the advent of internal mechanical environmental control systems. In this analogy, internal space use, built configuration and building cross-section need not be related to the external environment. Freed from external climatic influences, a wider range of design options are possible, whereas this would be more constricted in the open-system analogy. Obvious examples of such buildings are the large enclosed shopping malls, the multi-storey enclosed atriums in offices and hotels, etc. Most of the recent urban buildings in Asia have been based on this model. Very often the closed system analogy extends to not only the physical exchanges across the system envelope but also to social and cultural exchanges. By being closed, the internal environment can also be culturally insulated from the cultural context of locality.

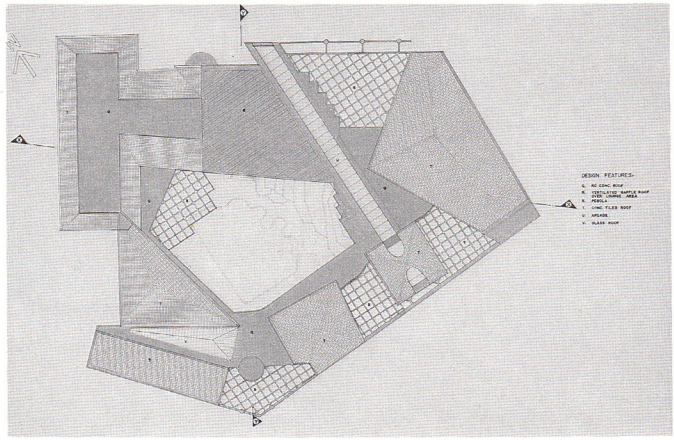
The antithesis to this is the open-system analogy in which the function of the building enclosure is regarded as a perforated barrier or as an *environmental filter*. The filter acts as a sieve that enables selective exchanges between the external climate and the

Composite Filter Roof with Vernacular Form as Canopy over Community Areas
The contemporary construction of the louvred roof form is localised in this composite roof combined with the traditional pitched vernacular tiled-roof form, into a single tiered layered roof that serves as a large canopy over the community spaces below.

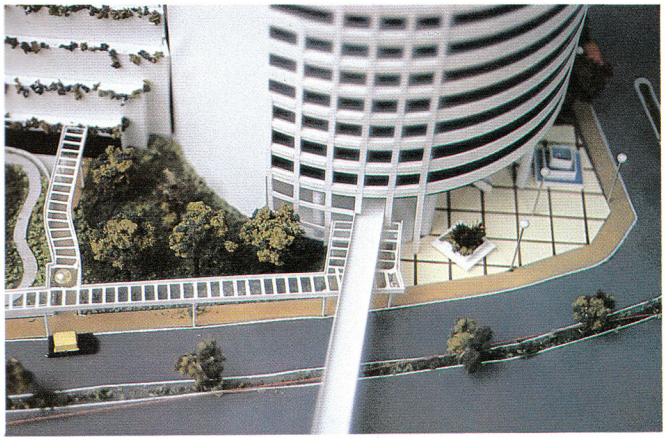


The Filter as Web
Right: Double Filter-Roof over a set-back building configuration.
Right, below: Detail of Set-back section
The building enclosure might be perceived as consisting of a series of layers of continuous webs serving different internal-climatic control functions.



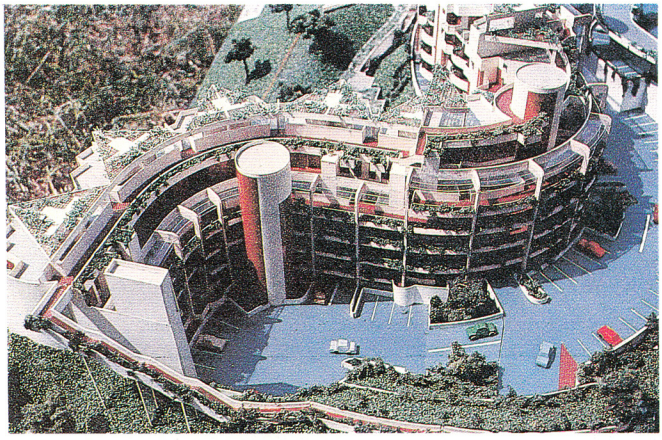


Multiple Roof Systems related to Internal Space Use
In contrast to the continuous web, is this assemblage of filter-devices whose configuration relate to different internal use. The range of devices include: zee-profile with fixed glazing, profile with adjustable louvred glazing, profile without glazing, vertical slats, inclined slats, baffle slats, glazed sky-lights, conventional tile, composites of slats with adjustable glazing.

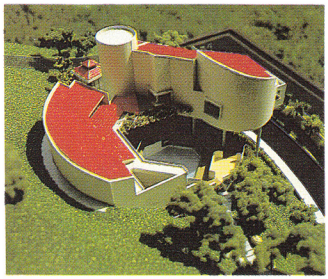


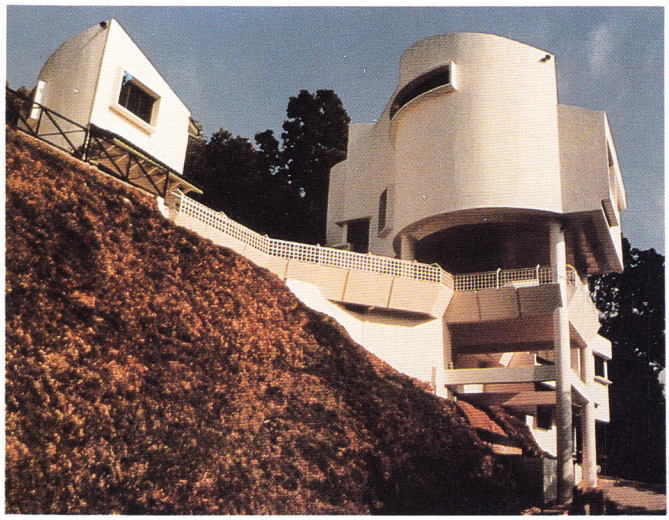
Trellised Walkways
The louvred section and zee-profile can be used not only for roofs but for the walls and floors in the building. The use here is to provide linked verandahways between buildings.

Linked Trellised Walkway System
The filter roof extends from the totally enclosed spaces to trellised walkways and public pergola plazas.



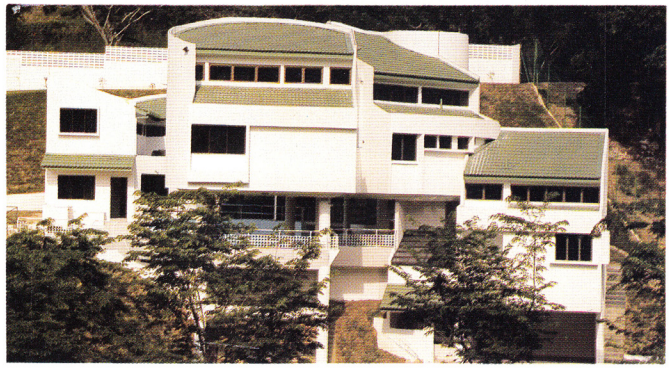
Filter Screen over External Wall
In the tropical climate, the single-loaded corridor provides the best cross-ventilation. This serves on the one side of the building as sun-shading to the inner-walls. Another filter screen is located at the other side of the building.

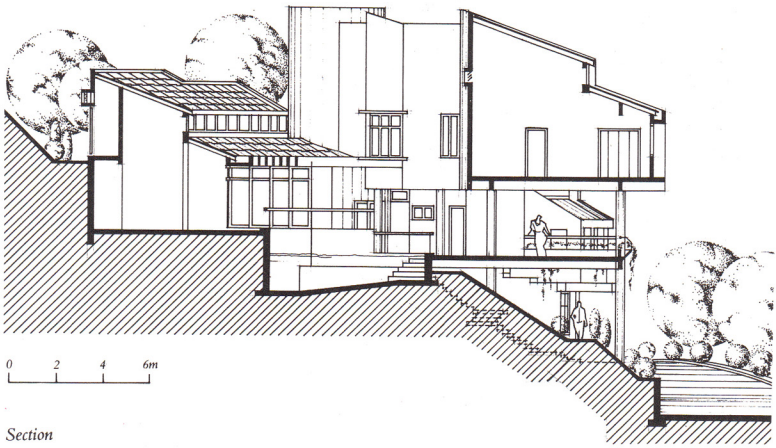




D-House

Above and right: Hillside residence.
Right, below: Street elevation.
D-House is a hillside residence that is wedged against the side of the hill. The courtyard in the tropical hot-humid climate need not be totally enclosed. Adapting the courtyard form from the traditional house, the courtyard here is opened up at the east corner to serve two functions: to provide a view corridor downwards from the internal living spaces to the valley across the site and to provide a ventilating channel for cross-ventilation. The plan is fragmented to increase external-wall area to the building for effective cross-ventilation and to create spatially a set of linked pavilions. The prevailing wind-flow is East to Westwards and the apertures of the openings and layered roof-forms are positioned to encourage controlled cross wind-flow through the building.





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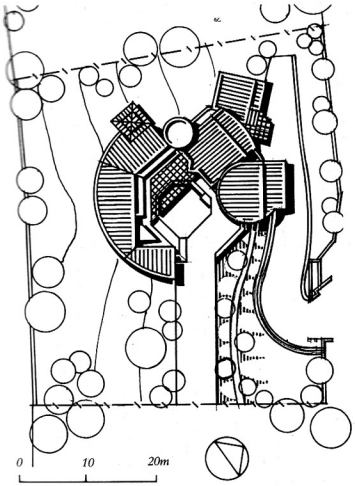

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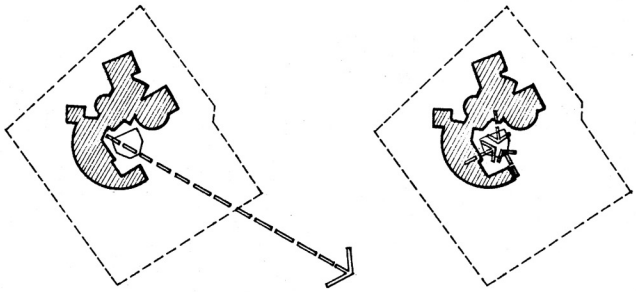
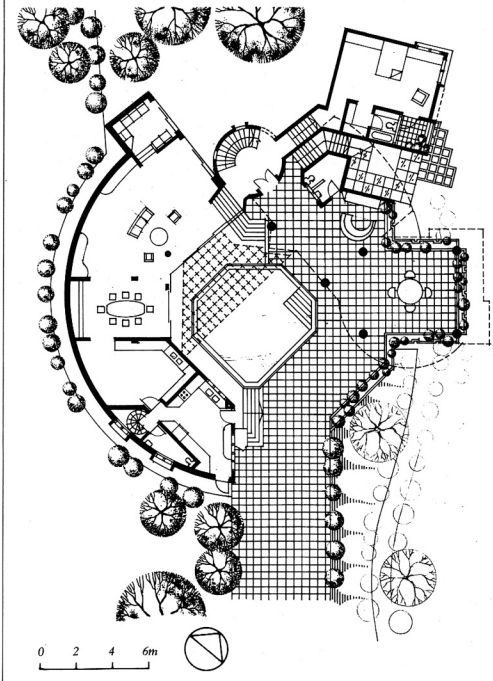
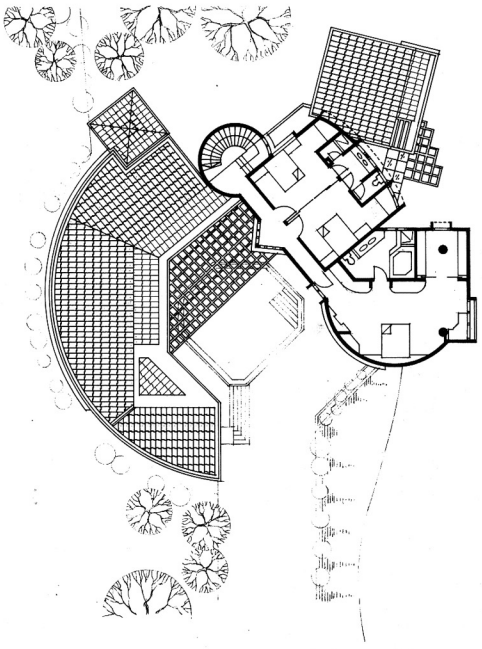


View corridor to valley below

Semi-enclosed courtyard



First floor



Second floor

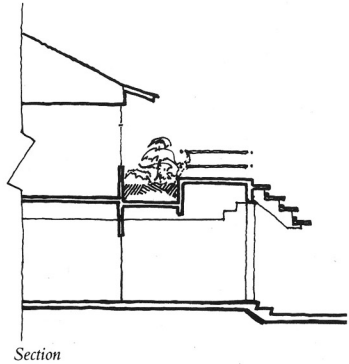
internal spaces that are designed to achieve the desired internal conditions. In buildings adopting this design approach, some of the outside natural climatic elements, such as wind, rain and solar radiation, are sieved by their enclosural systems so that certain unwanted influences are excluded while those which are desirable are admitted. The action of these exchanges and interactions across the fabric of the enclosure become important factors in influencing the design of the building itself. They should influence for instance, the configuration of the built form, the materials used, the method of assembly, the cross-section of the building, the building orientation and the internal space organisation. Examples of such buildings are those that have been designed to respond to the ambient climate.

Much of the existing vernacular that have been built before the advent of airconditioning function as open systems and make use of the natural climate to create comfortable internal conditions. In this analogy, the transitional spaces in a building such as the verandahways, porches, terraces, are *intermediary enclosural layers* and play a further environmental mediating role in the enclosure. The structural climatic control devices such as awnings, screens, blinds, louvres, *brise-soleils*, shutters, wind-catchers, etc. constitute the essential component sieving functions in these enclosures. In effect, the general systemic principle underlying the climatic performance of most tropical vernacular architecture is as an environmental sieve. In Malaysia, this applies to the traditional Malay *kampong* timber houses as well as to the composite masonry and tile Colonial administrative buildings and the Chinese shophouses, mansions and Association buildings.

Particularly in the tropics where designing with the climate is traditionally prevalent, the open-system analogy is therefore inevitably more appropriate than the use of mechanical environmental controls. The built environment requires less energy since it is less dependent on artificial airconditioning and artificial lighting, and on costs grounds it might be held to be preferred in the context of a developing nation with economic priorities. However, the consistency of comfort level of the internal environment as a result of the structural controls are not comparable with that of the mechanically controlled closed-system analogy since environmental changes are produced by the diurnal variation of climatic factors.

The choice of analogy and the determination of the degree of sophistication in mechanical controls might be regarded as being a socio-economic question. For although we have the technology at our means to create and to maintain virtually any specified set of habitable indoor conditions, both our preferences and the refinement of control-installations in the building design will

Inclined Louvres
Far left: Louvred canopy.
Far left, below: Internal view.
The profile of the zee-section becomes straightened into slat-form when used in the inclined plane.



Section

Plaza Atrium

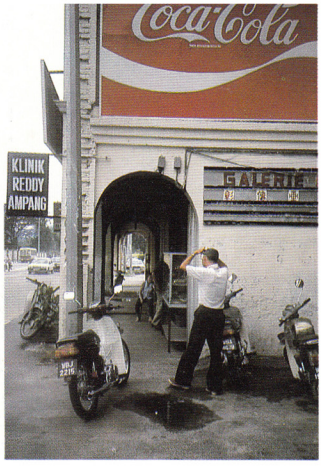
Right: The atrium as a transitional space.

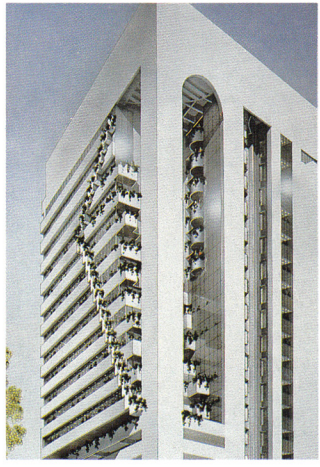
Below: Atrium form as analogous to shophouse verandahway.

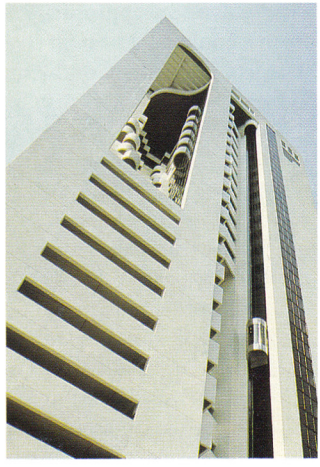
Below, centre: The transitional space as a large wind-scoop.

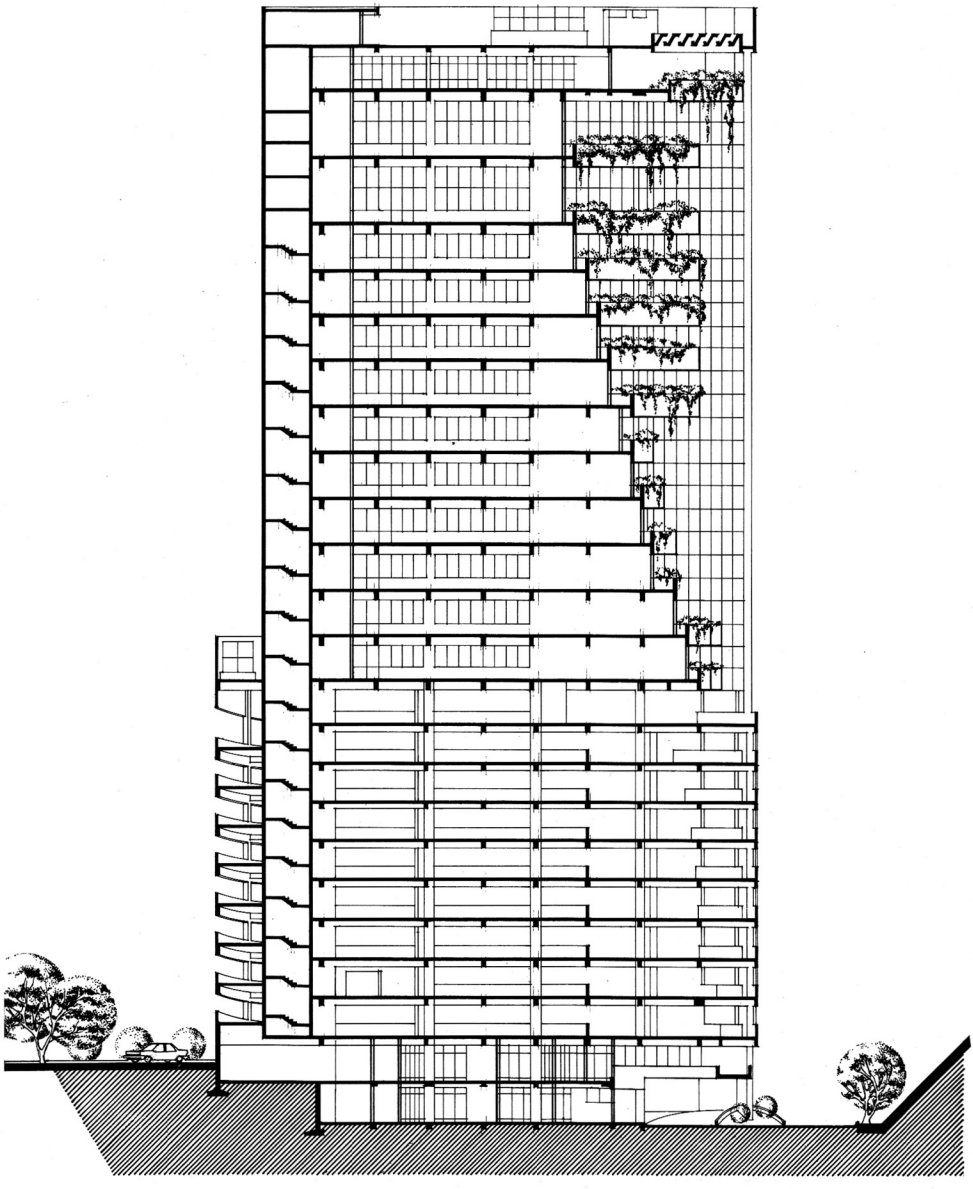
Below, far right: Stepped terraced office floors.

A direct continuity in built form is made between the arched verandahway and traditional porch form existent in the Malaysian architectural heritage with the arched atrium form in this high-rise urban archetype. The premise for the atrium in the tropics should not be as an insulated space inside the building but should be a transitional space located in the in-between buffer zone between the inside and the outside of the building. In this building, the atrium acts as large wind-scoop topped by a zee-profile filter roof. Each of the stepped upper floors have large terraces and planting zones facing the atrium space. An indirect historical connection is made by the atrium as a high-level in-between space with the principle learned from the transitional spaces in the traditional verandahway.





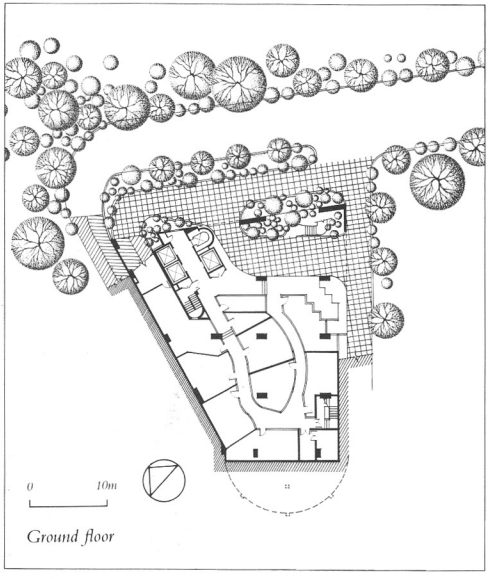




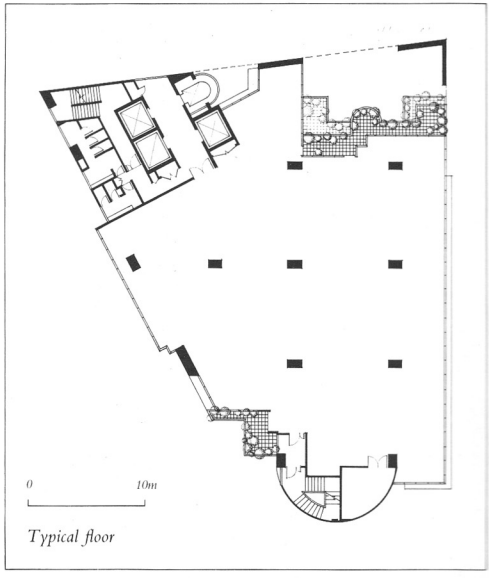
Section

The Atrium as a Space that links the ground floor to the upper floors
Above: This scheme is a development from the Plaza Atrium building, in which the atrium now spatially extends continuously from the ground level to the uppermost floor.
Far right: Planting terraces inside atrium.

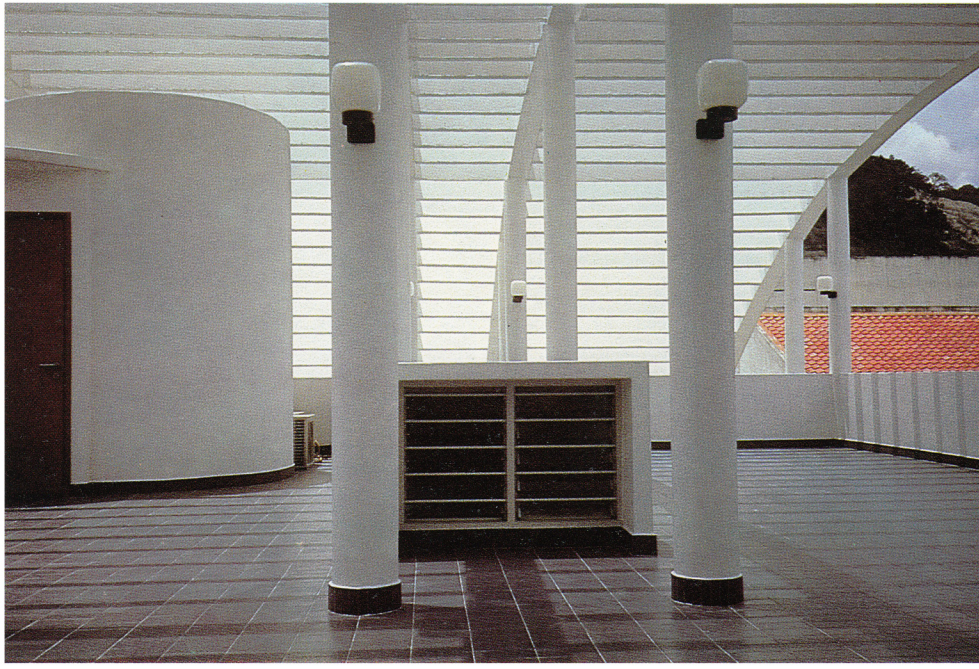
Site

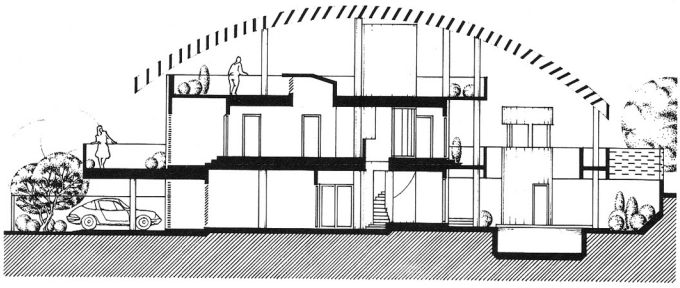


Ground floor



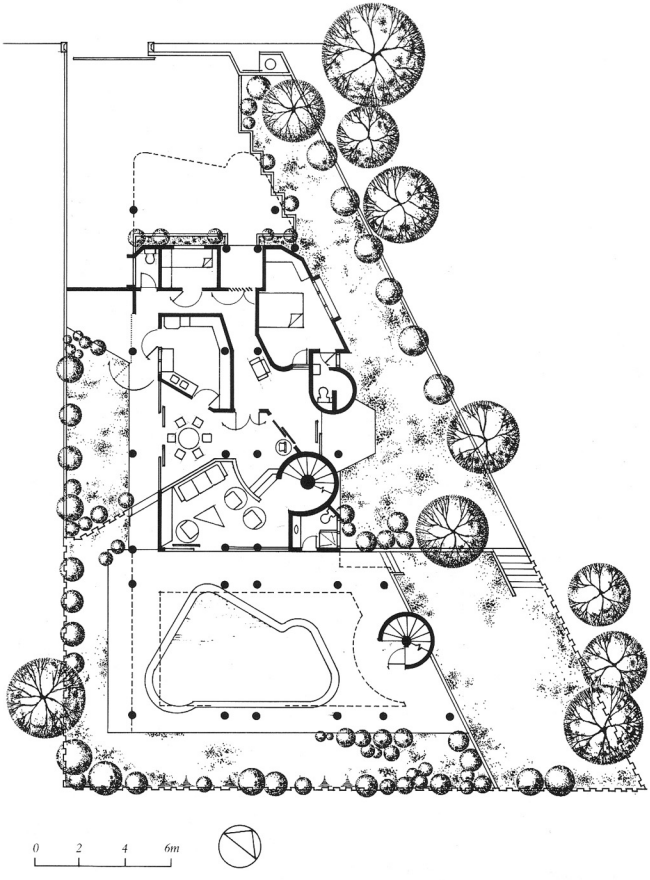
Typical floor



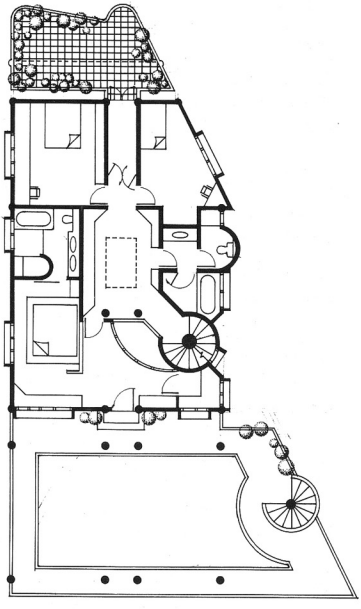


Section

Roof-Roof House
Far left: The filter roof as an oversized umbrella
Far left, below: Ventilator over internal stair-well

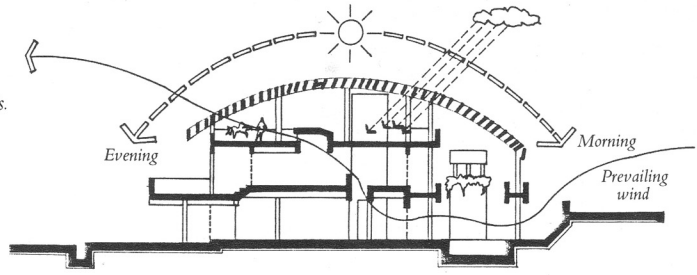


Ground floor

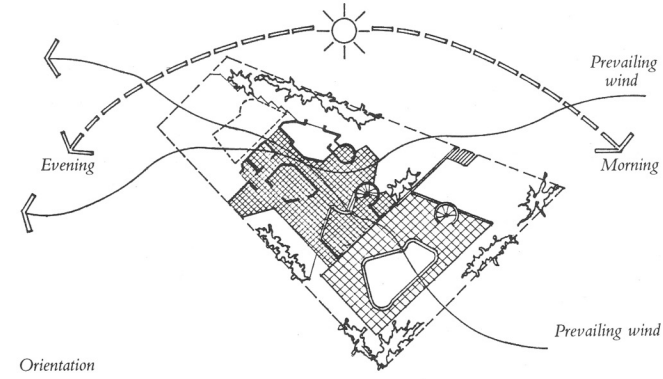


First floor

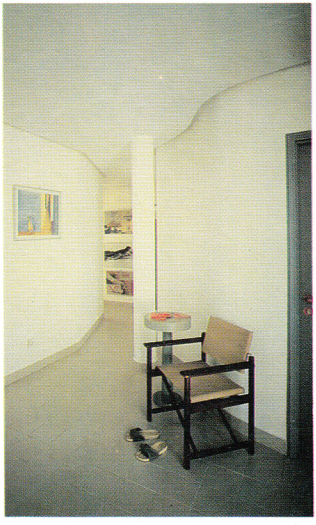
Below: Living Space.
Bottom: Transitional passageway space.
Bottom, right: Operable parts and blinds.
Far right: Poolside.
Based on the idea of the umbrella as a partially enclosing shelter in the tropical climate, the building is designed as a large single louvred umbrella in which the living spaces are located underneath.
A radiating floor plan creates integrated courtyards from the residual external spaces between the building and the site fencing.
Internal moveable panels combined with operable external glass doors and blinds can be adjustable at will by users to achieve desired internal micro-climate. Positions are varied depending on time of day and external wind-flow direction.

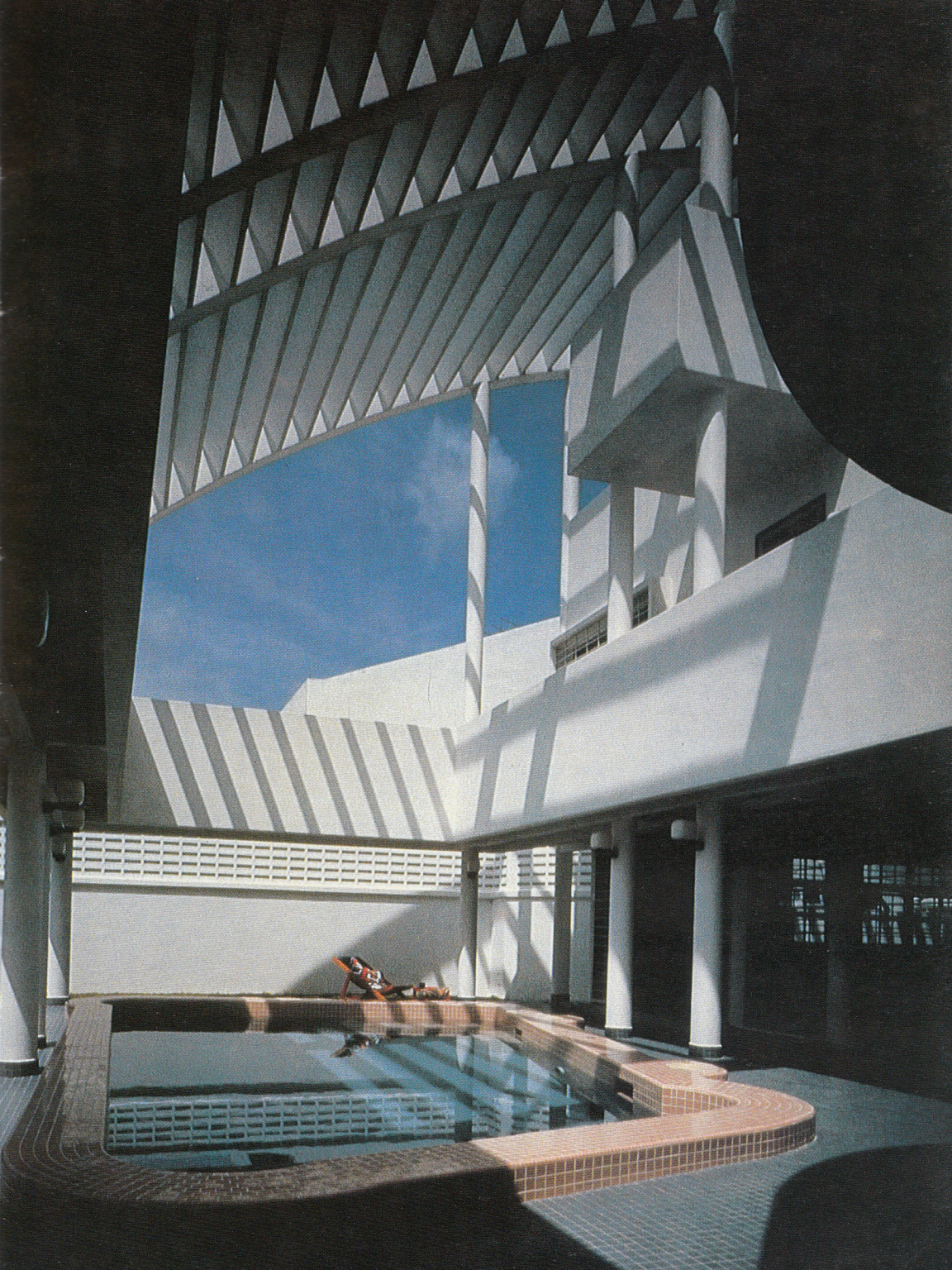


Section showing climatic responses

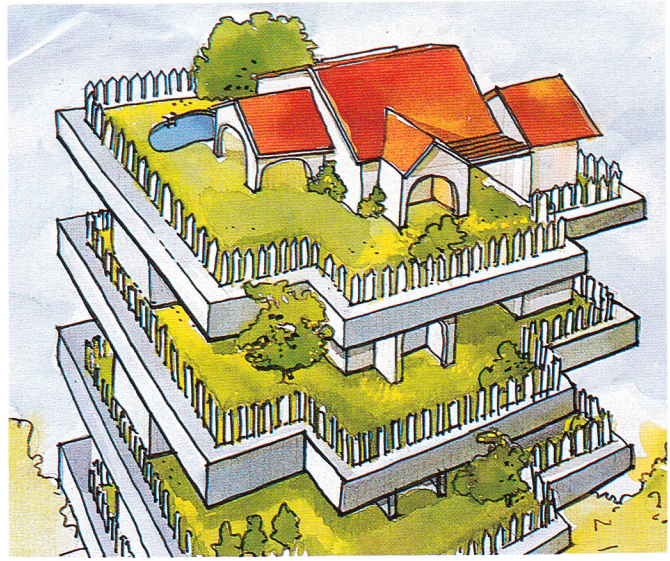


Orientation

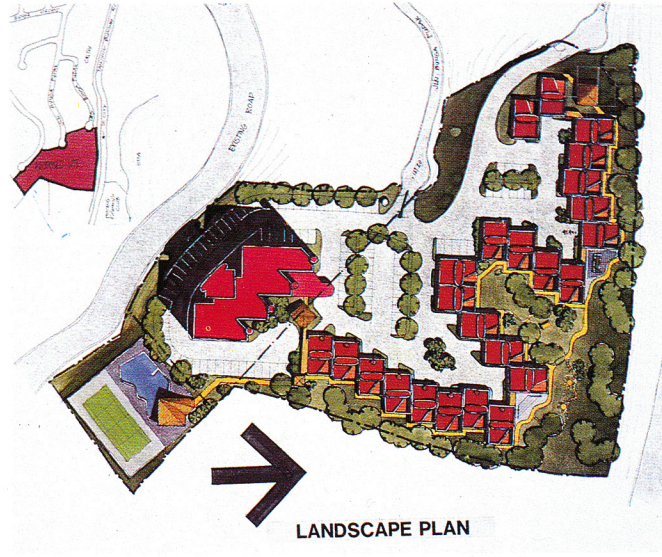




depend on the social status and the living standard of that society and the financial means available. The question is also the degree of consistency of environmental controls that we want to achieve and how much are we prepared to pay for it. Obviously where assistance to providing comfortable conditions can be obtained from the natural environment, we should try to make full use of it.



Gardens in the Sky
The idealised version of the house with its own garden in the sky in a high intensity urban context. The design question is to how to achieve this.

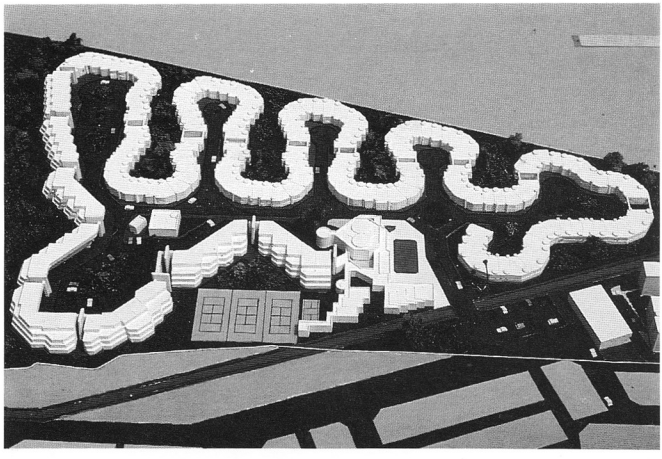


Continuous Landscaping
An exploratory drawing in which vegetation and landscaping are planned as a continuous irregular strip around the built form and which is not ecologically partitioned within the site by impervious surfacing.

With the filter analogy, we cannot of course expect to solve all our problems of uncomfortable conditions in enclosure design by natural means only. The natural environmental elements have their limits. However, the architect could build the enclosure in such a way as to bring out the best of the natural possibilities of that place and obviate the need for or reduce to the minimum any mechanical (active) controls. In the regionalist design approach, the environmental-filter analogy might be regarded as being the more appropriate and preferred since the existing vernacular architecture has arisen albeit unselfconciously from similar climatic control premises and dependencies upon the climate of the place yet possess their own cultural identities in built form.

The filter model might be regarded as a mechanistic and direct analogy of the systemic functions of the building enclosure. *A filter is primarily a device through which solids, liquids and/or gases flow and which restricts some and permits others to flow through.* This open analogy forces a design approach to be dependent upon the natural environmental and climatic characteristics of the place. Influencing its design are therefore those climatic factors that directly affect human comfort: *air temperature, humidity, air movement, radiation.* The environmental filter has to handle these four independent variables simultaneously as well as others, such as view, spatial organisation, acoustics, culture, site constraints, etc.

In the design process, a configuration and image has to be given to the enclosural system. These then become susceptible to the regionalist design considerations of the location and the connections to be made. The proposition of the enclosure as an environmental filter therefore provides us only with a general and technical *armature* over which regionalist design interpretations take place. The designer has to synthesise these aspects into a built form.



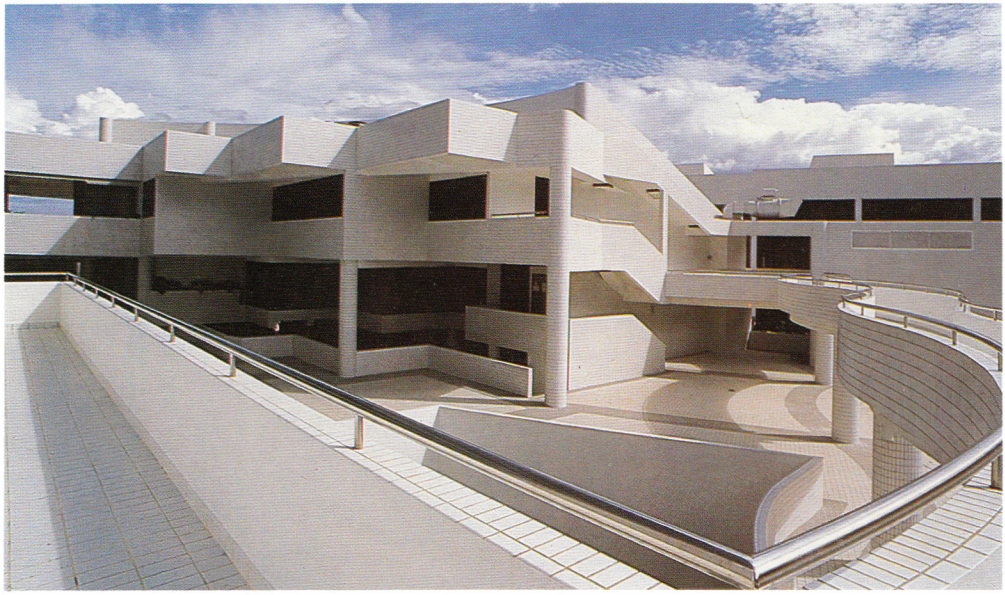
Integration of Continuous Landscaping with Building (Horizontally)
Maintaining a continuous landscaped open-space system within the site, the vegetation and green areas here are linked with buildings as in a weaving layout as in a clasped-hand formation. In this way, vegetation is integrated with building in a horizontal low-rise built configuration.

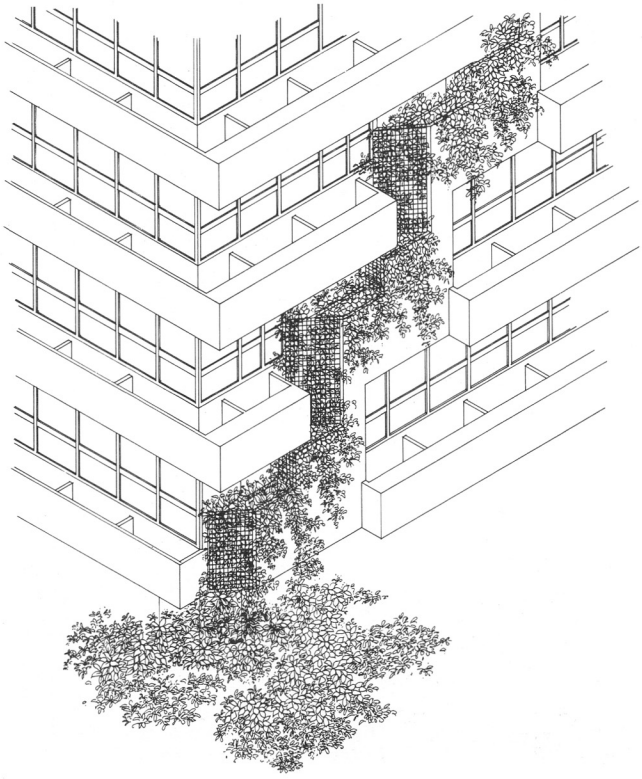
Plaza IBM

Right, above: Integration of landscaping with building (vertically).

Right: Side elevation of escalating planters.

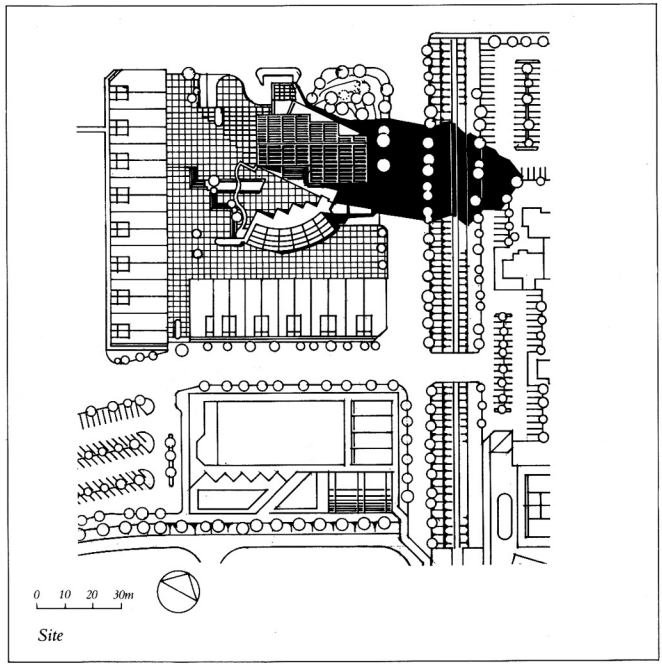
The integration of continuous vertical landscaping in the high-rise building type is resolved here using a system of escalating planter boxes combined with balconies. The planters start from a green patch at the ground level, then ascend diagonally upwards, traverses across the intermediate breezeway floor, and re-ascend again diagonally upwards to the upper part of the tower on the other side of the building, to the top floor terrace.



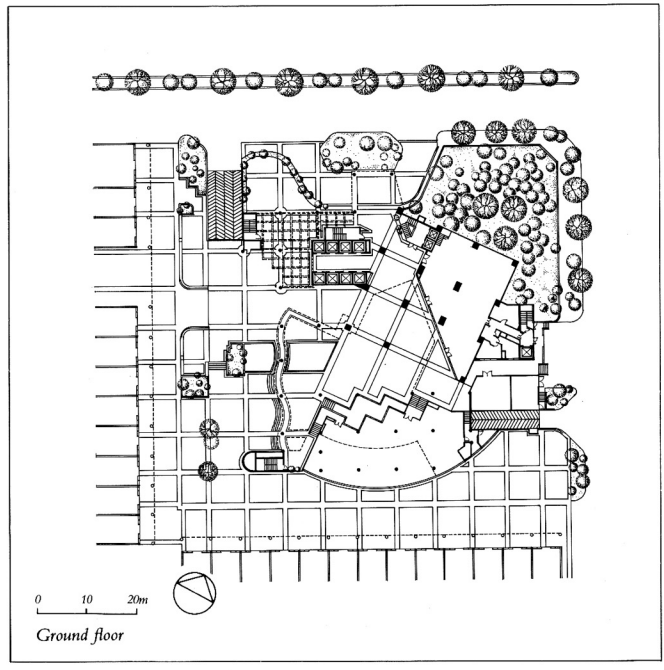


Above: Plaza bridge.
Left: Planter detail.
Sun shading is provided by an extended precast spandrel over the window areas.

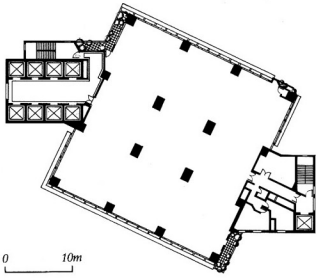
The geometry of the square typical floor plan is oriented North-South (to coincide with solar geometry) whereas the lift cores follow the geometry of the site.
Entry to the ground level lift lobby is open to the outside (not mechanically air-conditioned). The ground and plaza level provides an open thoroughfare between the residential development at the north of the site and to the plaza's restaurant complex and the shophouses at the south.



Site



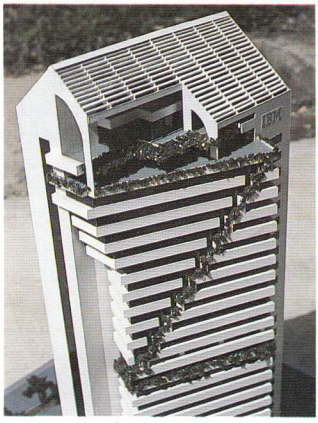
Ground floor

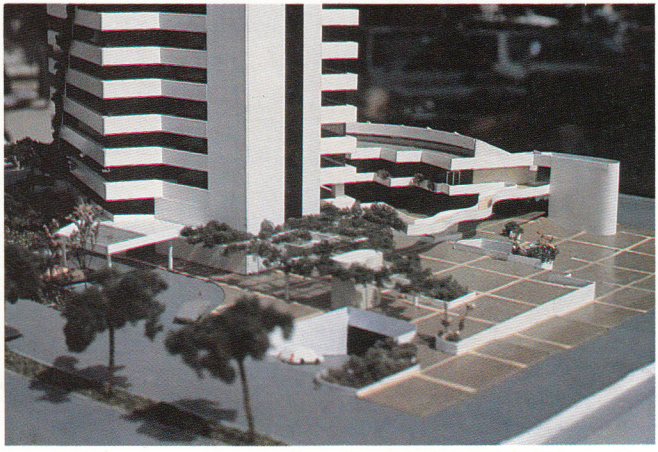


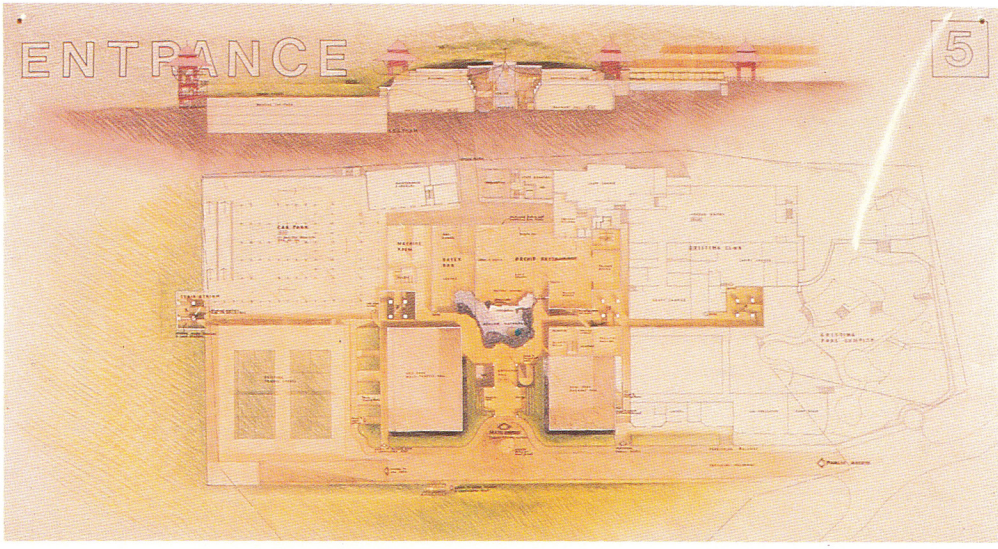
Typical floor

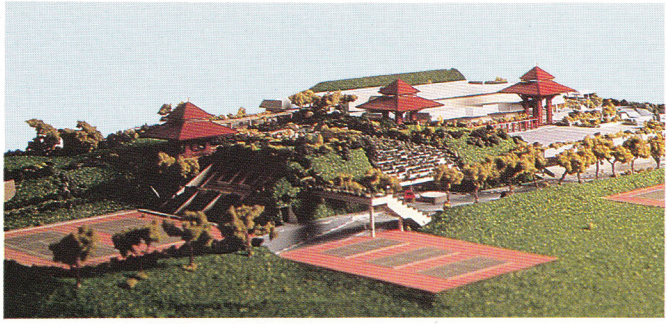
Section

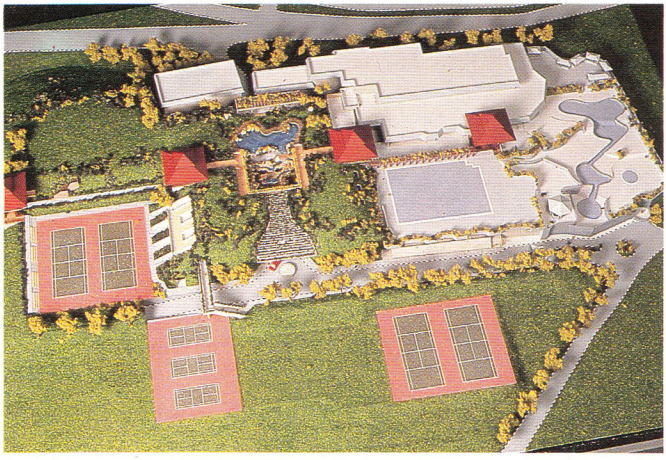
Right: Entrance porch.
Below: Detail of Roof.
Bottom: Model showing planting origination.
Bottom, right: Plaza.
The pitched roof form is used instead of a flat-top to the building to be representative of the image of the vernacular pitched roof form to maintain a direct connection with the historical form of the vernacular. In contrast to the pastiche additive of a non-functional tiled roof over the urban high-rise archetype, the pitched roof form here is constructed from inclined louvred slats in which underneath are the building's mechanical equipment and the roof top terraces.











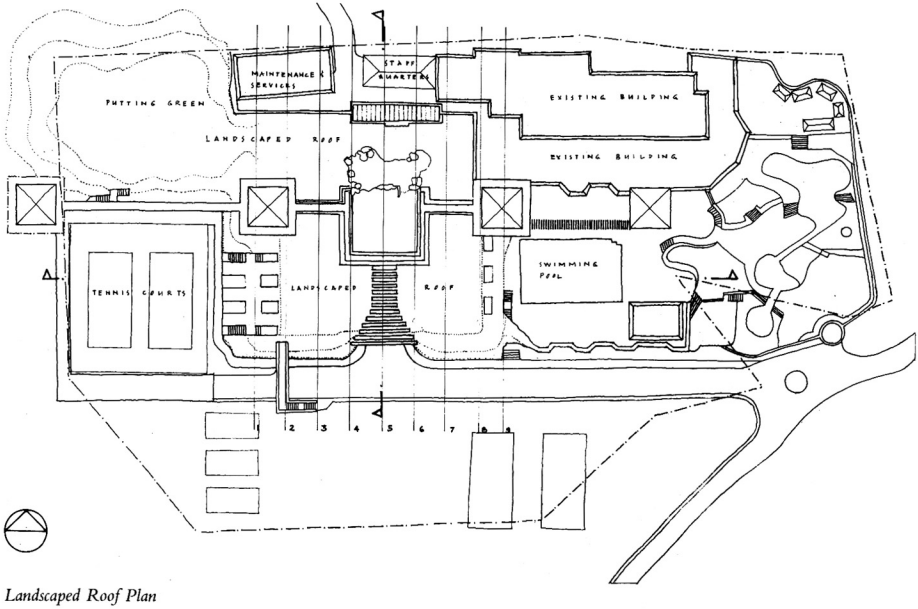
Lake Club Extension (Competition Design)

Top: Section of building showing continuous overhead planting linked with the vegetation of the surrounding gardens.

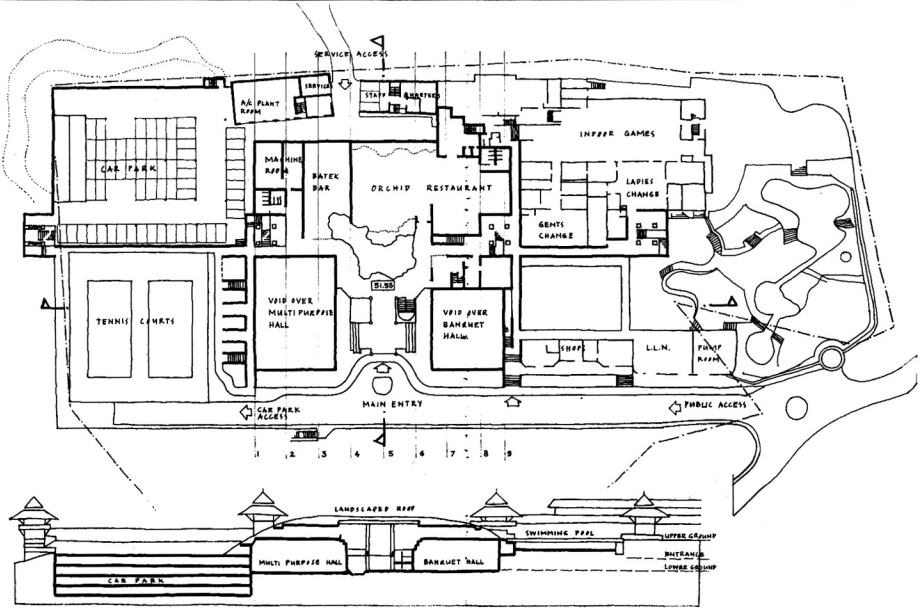
Left: Composite zee-profile roof with planter boxes over entrance to building.

Left, below: Continuous planting that extends over roof area.

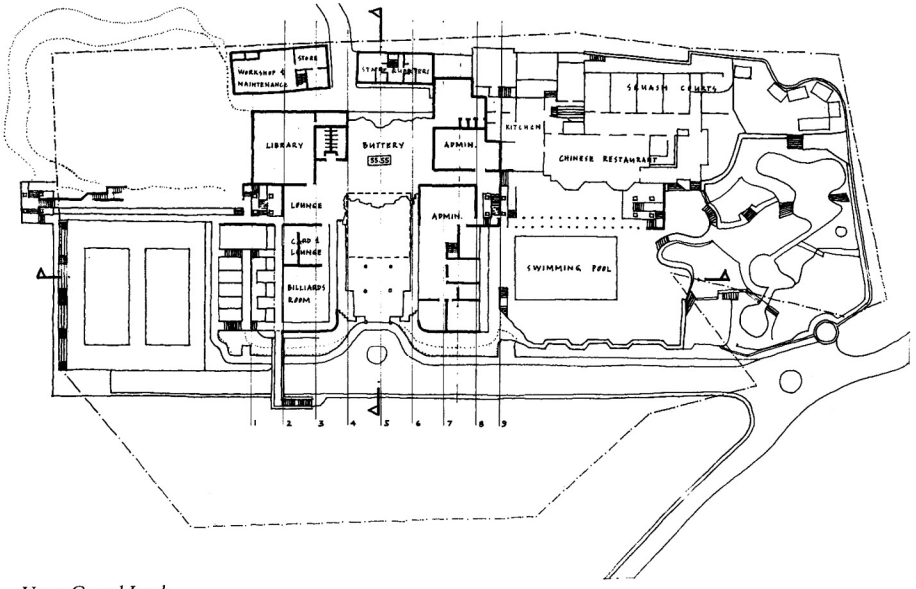
Design combines intentions to make a connection between the building with geography of site (hence a submerged building with planting on roof), the use of a central transition space (central waterfall atrium open to the sky) and use of composite zee-shaped roof over entrance area combined with continuous planter boxes. The building is designed to integrate man-made inorganic structures with existing natural vegetation in Lake Gardens which surround site. Internal circulation areas are naturally ventilated. A series of signifying stair towers are located along central axis, which also function as wind-scoops to bring ventilation to secondary courtyards and passageways.



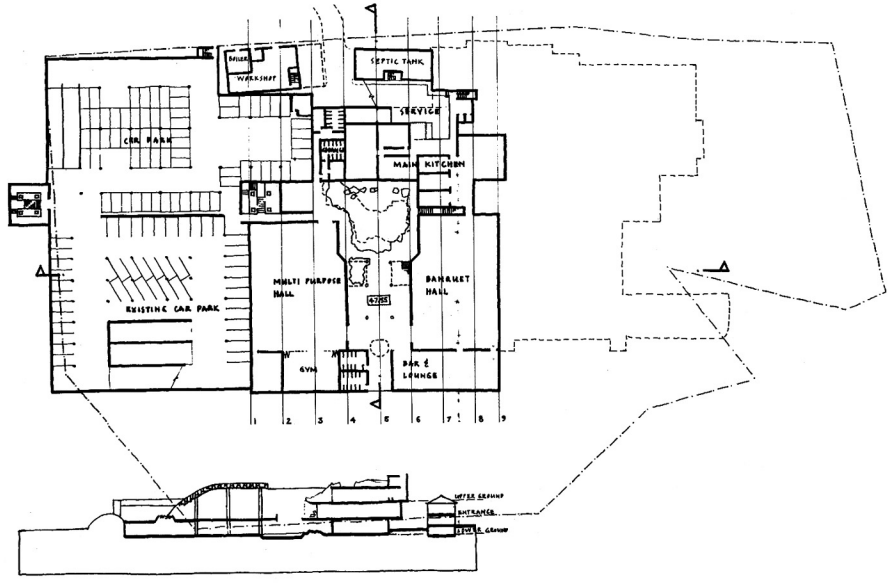
Landscaped Roof Plan



Entrance Level

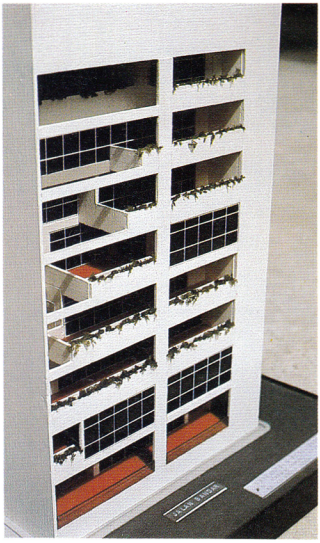


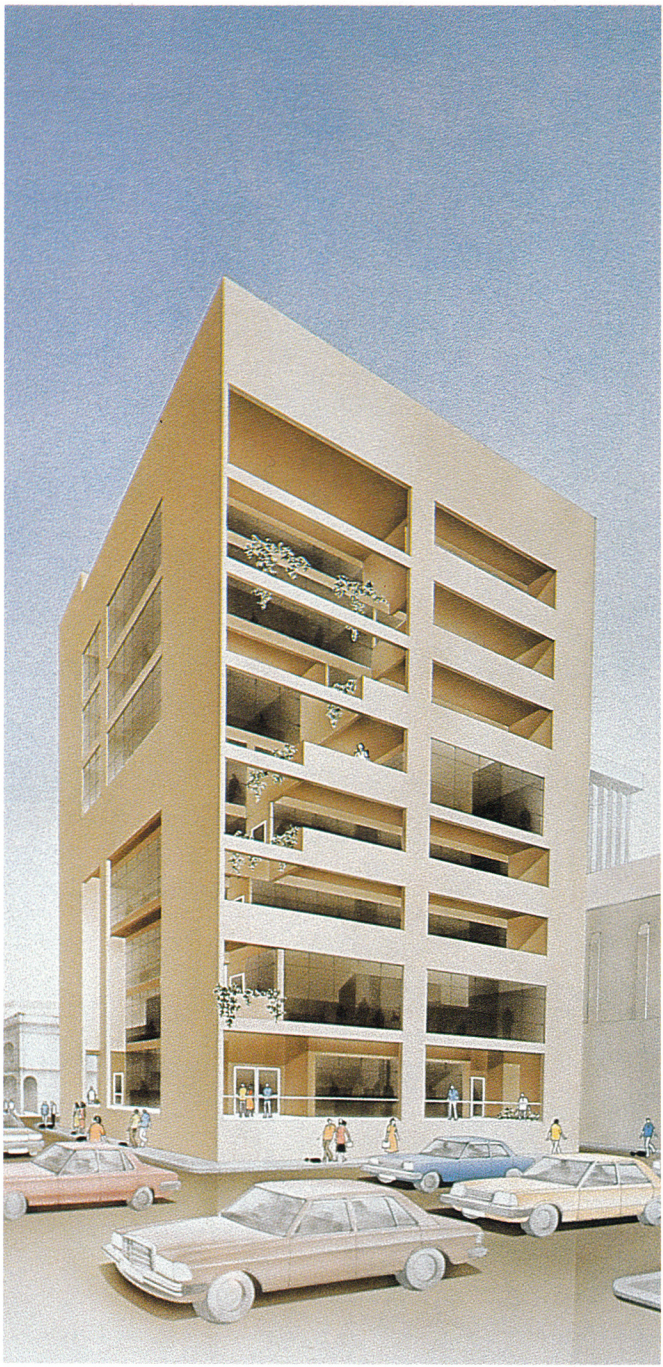
Upper Ground Level

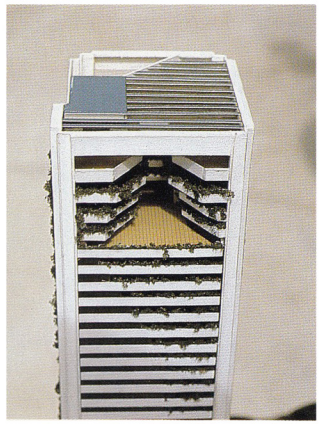


Lower Ground Level

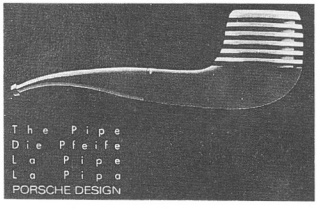
Sky Terraces
Below: Sky terraces
Right: Extending the transitional spaces upwards.
The design explores the introduction of terraces extending from the verandahway at the ground level upwards to benefit the other floors of the building.

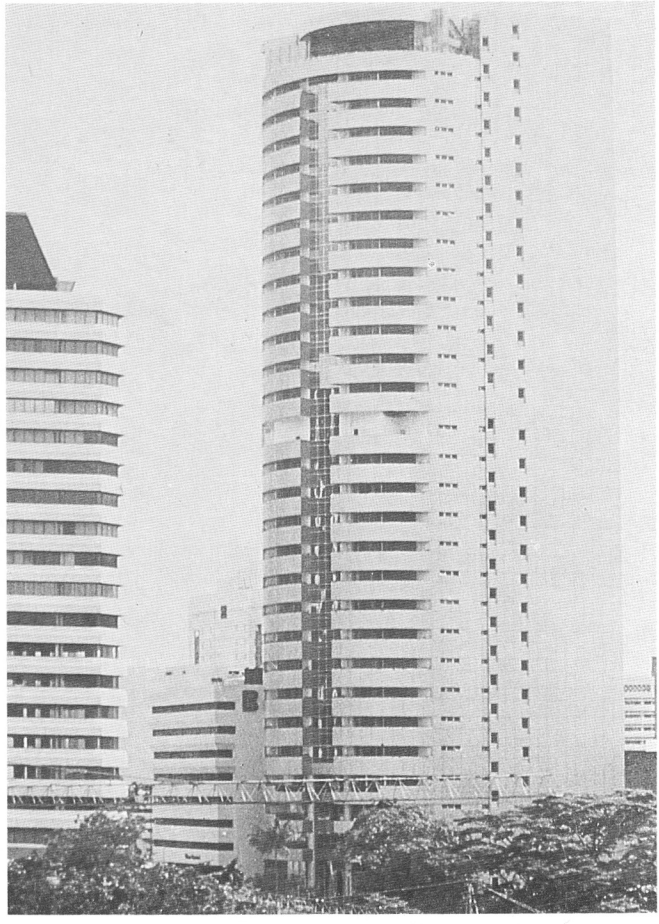




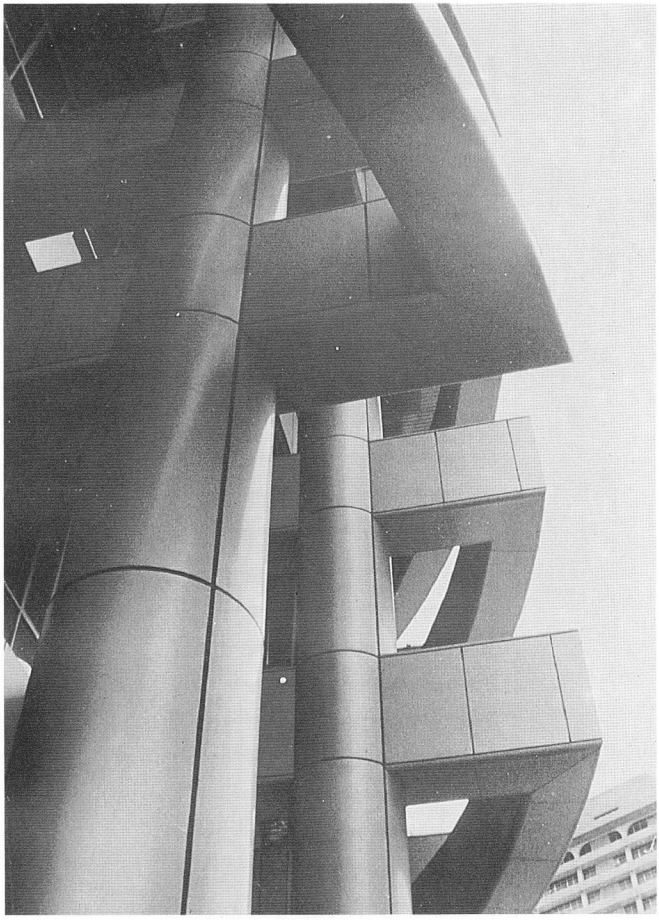


Sky Courts
Above, far left: Study model of locating terrace zones in the upper floors of the high-rise building type.
Above, left: An atrium is formed by placing a Zee-profile roof over the central sky-terrace.
Left: Sky courts in urban buildings
In relating climate with the urban high-rise archetype, the floors can be recessed within the builtform to provide sky-terraces with a ventilated filter-roof placed over the terrace.

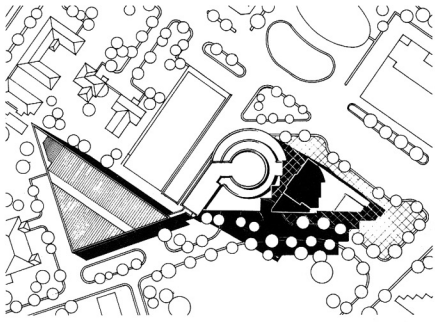




Menara Boustead
Right, top: Elevation with sky-terraces.
Right: North orientation of glazing face.
Top: Analogy with the cooling fins in the side of the engine cylinder.
Above: Analogy with the ribbed fins inside of the metal bowl of the pipe by Porsche.
In the same way that the fins in the engine serve as heat exchangers that increase the cooling surfaces to the external climate, the external wall of the tropical high-rise urban archetype could have a louvred profile to the external wall with a secondary skin that can serve as a heat-sink to reduce the structural heat gain into the building.



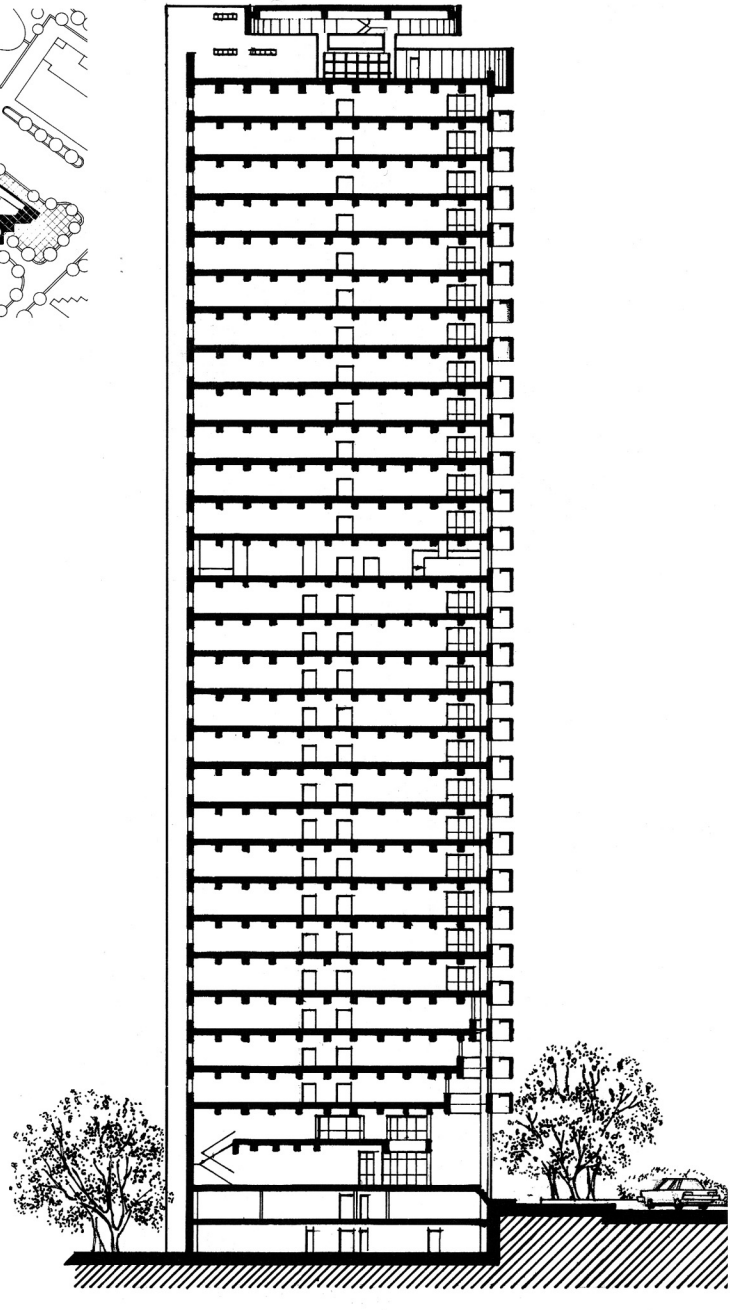
Left: Ribs over entrance.
Below, far left: Entrance lobby.
Below, left: Ground floor bank.
A composite aluminium panel cladding is used as a secondary skin over the masonry inner wall but separated by a ventilating air-gap.



0 10 20 30m

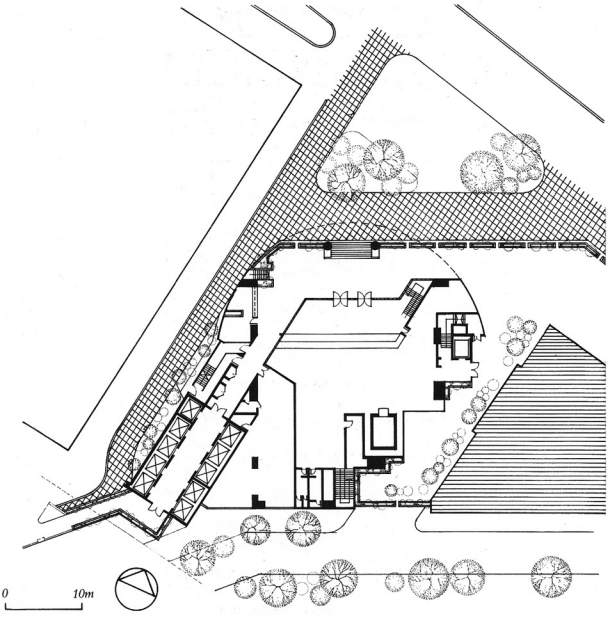
Site

The curtain wall glazing section of the elevation is oriented north having minimal solar insolation on this face. The key design feature to the typical floor is the location of a series of corner terraces (comparable to the traditional role of the verandahs) which provide a transitional upper-level multi-function space: as a zone for future executive wash-rooms, as garden terraces, as landscaping zones, as space for locating supplementary air-conditioning condensers, as flexible zones for executive rooms and kitchenettes. The main elevators and stair core and rest-room section are located on the west (hot) side of the typical floor. The regionalist building should also project the anticipated future image to the city. The edges of all the terraces have planter boxes giving the appearance of urban garden terraces in the sky; the tropical urban garden as a future image for the city of Kuala Lumpur.

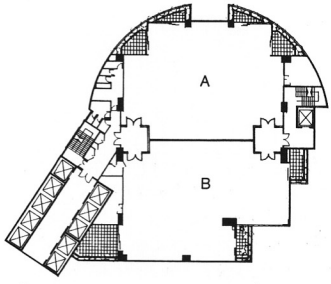


0 10 20m

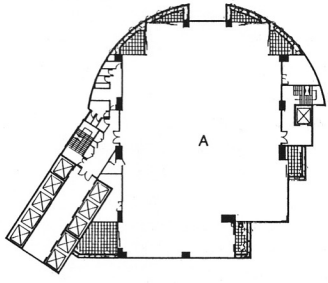
Section



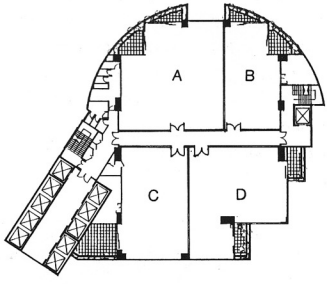
Ground floor



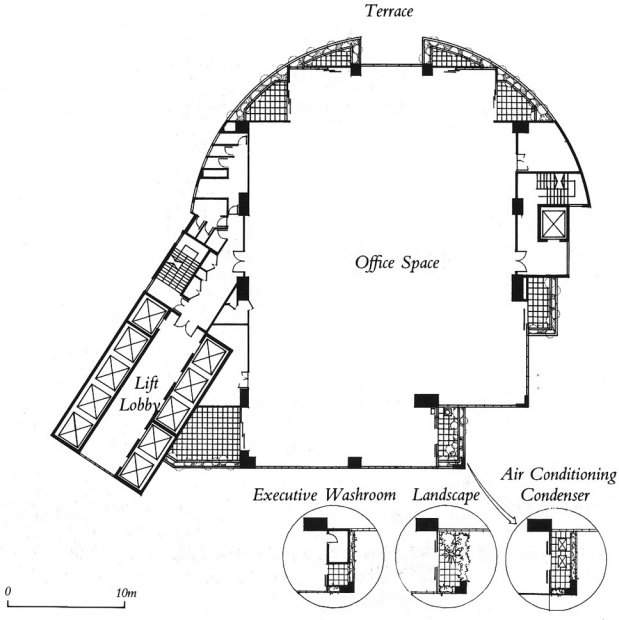
Double tenancy



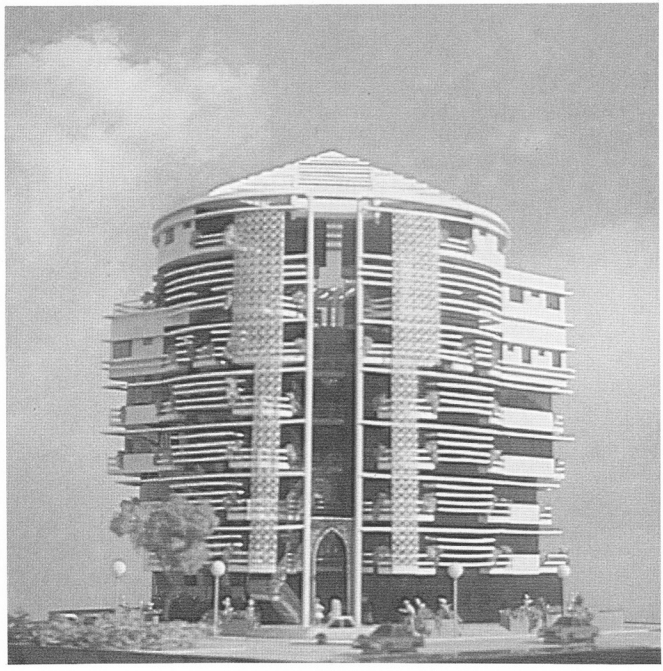
Single tenancy



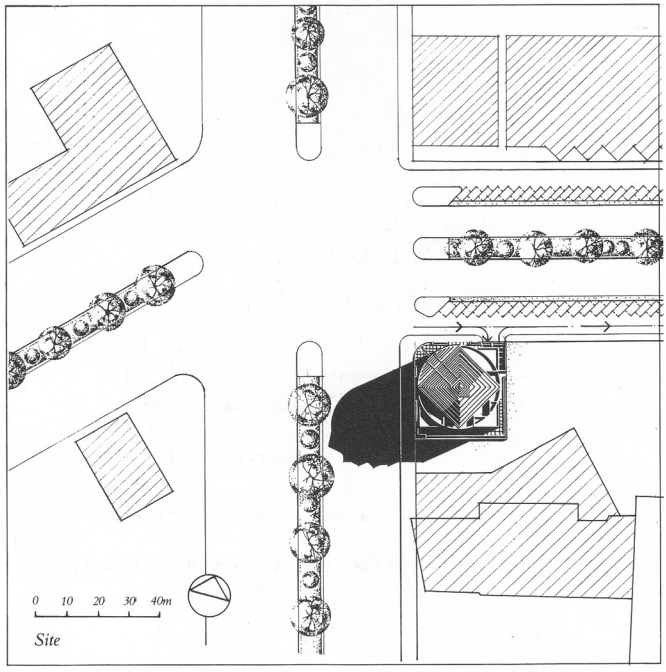
Multiple tenancy

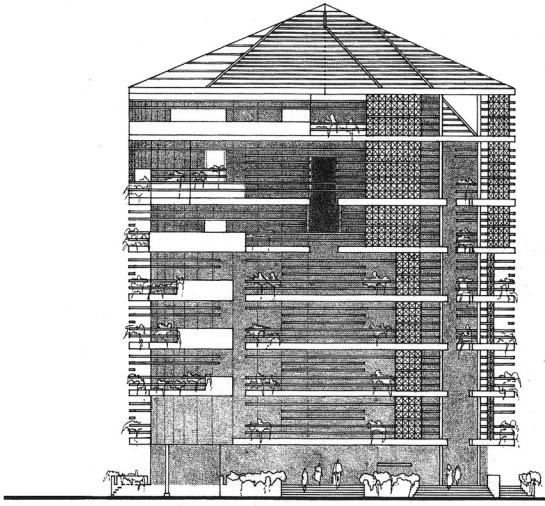


Typical floor showing sky-terraces

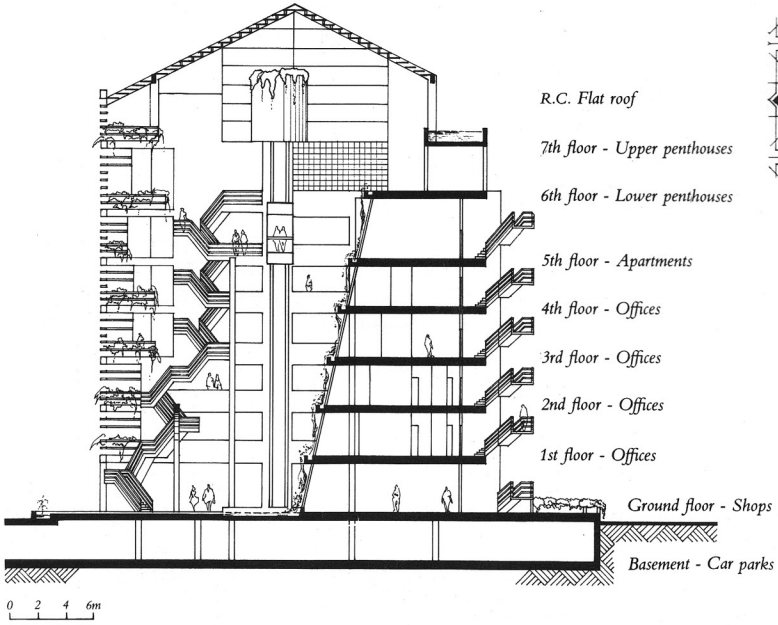


The SIAB-ZAAL Building
Right: Variable filter wall around the side of the building.
The environmental filtering function of the external wall is articulated in relation to the orientation of the face of the building and to the internal space use.

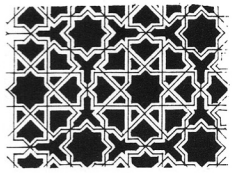




Elevation



Section



Detail of grille

4 Consequences

By regarding the building enclosure as an *environmental filter*, we provoke a critical questioning of the way we perceive the functions of the parts of the building enclosure. It becomes apparent that the various traditional components of the enclosure such as the roofs, walls, windows, doors, etc. and the different climatic control devices (e.g. awnings, canopies, eaves and overhangs, blinds, shutters, etc.) serve, in effect, a climatic sieving function in the tropical enclosure. Besides their other functions of providing access or views to the outside, our attention is brought to their roles as component *modifiers of the internal built environment.*

As with common principles of designing with climate, their orientation and position, size and design in the enclosure need to be *synchronised* with the changing environment on the outside and with the inhabitant's internal space use, the partitioning across the building section, the built form and other factors. The overall usefulness of the filter model is in providing us with a general systems armature for heuristic design explorations of building configurations, functions, materials, assemblies and space planning.

The concept is primarily a direct analogy of the filter. If we pursue the analogy further, we can contend that those moveable parts of the building enclosure such as the building's doors, window panels, adjustable blinds, louvres and awnings are analogous to the *operable parts* in the filter. Such parts permit adjustment by the individual occupants locally within the enclosure, and enable variability in the local micro-climate conditions within the enclosure to suit the occupant's mood and space-use requirements. These operable parts, being components of the enclosural system, provide the regulators for the control of the external-to-internal environmental modifying function of the enclosural system. In the analogy of a filter, the mechanical actions of the filter are to keep out certain things and permit others through. In those parts of the enclosural system where the filter has operable parts that regulate the sieving action, they operate in much the same way as a *valve* would.

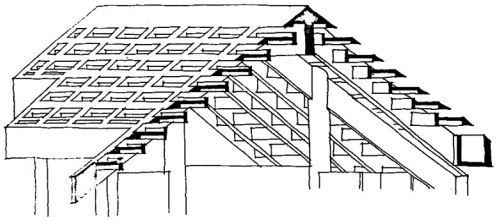
A valve is essentially a mechanical device for regulating the

flow of say, liquid, air or gasses by means of moveable parts that open, shut or partially obstruct one or more passageways. Interestingly, the archaic use of the word "valve" was to describe a leaf or a half of a folding or double door. The valve regulates the filtering of the undesired climatic elements but let in that which is condusive when adjusted. Found in the vernacular buildings are transitional spaces such as the entrance porches, the raised and recessed terraces, utility spaces, courtyards, atriums, passageways, air-wells, etc. These are spaces which are neither inside nor outside. They serve as buffer zones in the traditional building. In the context of the environmental filter they can be designed to serve as *conduits* for the desired climatic elements and as climatic modifiers in addition to their conventional spatial, buffer and aesthetic vernacular roles.

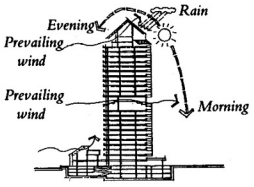
The consequences of the filter model are related primarily to those premises for designing with climate. An awareness of the general climatic indicators of the zone in which the building is to be located provides us with the broad bases for the design of the filter. In any case, these have traditionally been the design principles underlying much of the architectural heritage of a place and by our seeking to design with climate, an indirect regionalist connection would be simultaneously pursued.

In case of the hot-humid tropics such as where Kuala Lumpur is located, the hot discomfort conditions require that the environmental filter be designed to prevent heat gain, to maximise heat loss and to remove any excèss heat by cooling, preferably without the use of supplementary energy supply. Efforts at designing with climate does not necessary mean a complete dispensation with mechanical means or with supplementary energy supply, as we should not expect to solve the problems of uncomfortable conditions by natural means only. Those environmental elements aiding us have their limits. Where mechanical controls have to be resorted to, their task can be reduced to a minimum. However, it must be recognised that in design, trade-offs are often unavoidable.

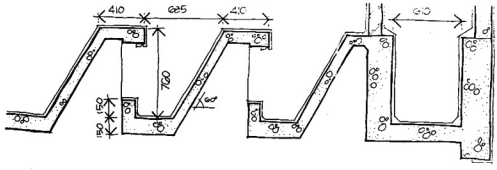
Generally in this hot humid tropical belt, there is very little seasonal variation throughout the year. The only punctuation are periods with more or less rain and the occurance of gusty winds and electric storms. The most prominent characteristics of this climate are the hot, sticky conditions and the continual presence of dampness. The air temperature (DBT) in the shade reaches a mean maximum during the day of between 27°C, and 32°C, but occasionally it may exceed the latter value. At night the mean minimum varies between 21°C and 27°C. Air temperature remains moderately high, between 21°C and 32°C, with little variation between day and night. It seldom exceeds normal skin temperature. Both the diurnal and annual ranges of temperature are quite narrow.



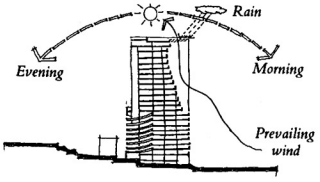
Louvred pitched roof form with slats placed at the incline with a lip at the inner edge



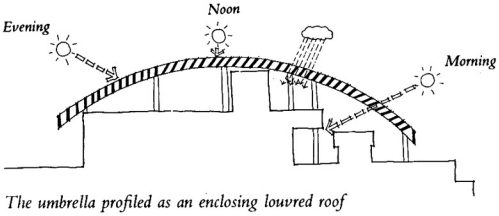
Building Orientation



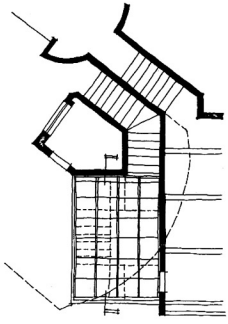
Zee-roof over atrium



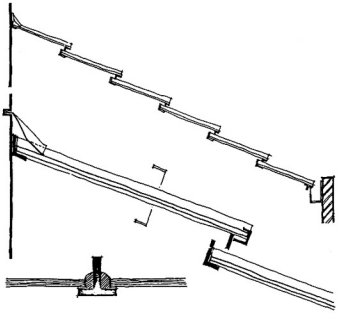
Climatic responses



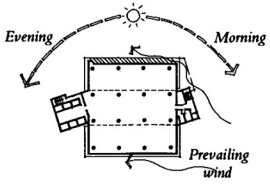
The umbrella profiled as an enclosing louvred roof



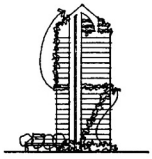
Glass filter canopy



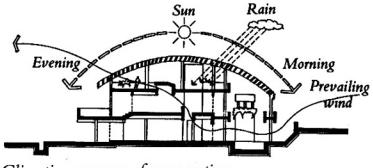
Detail



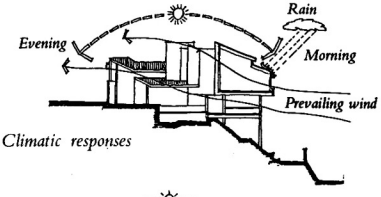
Coincidence of North-South geometry of the typical floor plan with the solar geometry.



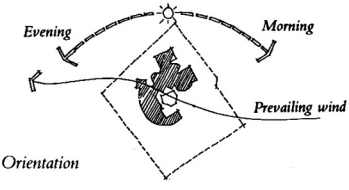
Escalating vertical landscaping



Climatic responses of cross-section



Climatic responses



Orientation

The Enclosure as Filter
A set of possible interpretations of the filter analogy in which a number of different profiles and composites are used to explore the sieving role of the enclosure in the tropics.

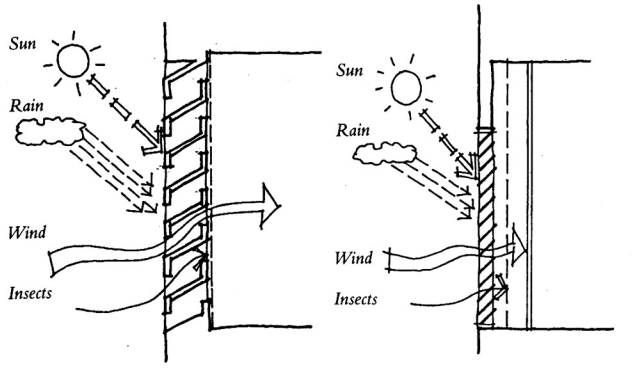
The humidity (RH) remains high during all seasons at about 50% for most of the time, but it may vary from 55% to almost 100%. Vapour pressure is steady in the region on 2500 to 3000 N/m^2. Humidity is high during all seasons. Heavy cloud and water vapour in the air act as a filter to direct solar radiation, which is thus reduced and mostly diffused; but clouds also prevent reradiation from the earth at night. The precipitation is high throughout the year, generally becoming more intense for several consecutive months.

Annual rainfall can vary from 2000 mm to 5000 mm and may exceed 500 mm in the wettest month. During severe storms rain may fall at the rate of 100 mm/h for short periods. The need to discharge this rainfall from the tops of building influences the shape of the traditional roof form. The sky conditions are fairly cloudy throughout the year. Cloud cover varies between 60% and 90%. Skies can be bright, a luminance on 7000 bcd/m^2 or even more when it is thinly overcast or when the sun illuminates white cumulus clouds without itself being obscured. When heavily overcast, the sky is dull, 850 cd/m^2 or less.

Solar radiation is partly reflected and partly scattered by the cloud blanket or the high vapour content of the atmosphere; thus radiation reaching the ground is diffuse but strong, and can cause painful sky glare which influences the emergence of deep eaves and canopies in the Malaysian vernacular.

In this zone, cloud and vapour content also prevent or reduce outgoing radiation from the earth and sea to the night sky, thus the accumulated heat is not readily dissipated. The wind velocities are typically low with frequent calm periods, but strong winds can occur during rain squalls, i.e. Gusts of 30 m/s. The moisture in the air combined with moderate heat and high rainfall favour the growth of vegetation. Vegetation grows quickly in this climate due to frequent rains and high temperatures and is difficult to control.

The red or brown laterite soils are generally poor for agriculture. Plant-supporting organic substances and mineral salts are dissolved and washed away by rainwater. The subsoil water table is usually high and the ground may be waterlogged. Little light is reflected from the ground. Generally the high humidity accelerates mould and alfal growth, rusting and rotting; organic and biodegradable building materials tend to decay rapidly. Although timber is an indigeneous material, its application in intensive urban conditions is not in all instances appropriate and some chemical treatment is needed. Mosquitoes and other insects also abound, and screens are needed to filter the insects but let air through. The thunderstorms are accompanied by frequent air-to-air electrical discharges.



Variable layers in the filter wall (zee-section with insect screen)

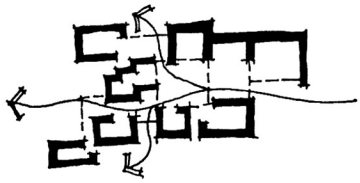
Louvred wall with insect screen and sliding glazing panels

Operable parts
A valve is essentially a mechanical device for regulating the flow of say, liquid, air or gases by means of moveable parts that open, shut or partially obstruct one or more passageways. By analogy the external wall and roof of the building might have moveable parts that can be adjusted by the users to achieve desired internal conditions.

An awareness of the physiological objectives of building users provides us with bases for both internal space design and the design of the environmental filter. These factors also enable a better understanding of the cultural traditions, lifestyle, dress and customs of the place. The four basic factors which directly affect human comfort are *air temperature, humidity, air movement* and *radiation*. The importance of these should be obvious: each influences in some way the heat exchange processes between the human body and its environment, and may aid or impede the dissipation of surplus heat from the body. For example, high air temperature is a definite obstacle to heat dissipation by convection (it may even produce a heat input if warmer than the skin), and simultaneous high humidity may impede the heat loss by evaporation.

In the regionalist approach, it is necessary to analyse how in the existing heritage of the place the various parts of the enclosural system are interpreted through analogy. We need to investigate how the walls, roofs, windows, doors, shading devices, porches, terraces, floors, etc. in the traditional building served as environmental filters in the traditional enclosure. In analysing and designing the enclosural filter, the following aspects need to be considered: *their positions, the orientation of the surfaces in the enclosure, the disposition of the floors in the building and the external features of the enclosure*. For instance, where the flow and exchange of air movement provide ventilation through the enclosure, the extent of filtering determines the level of openings in the enclosure with regards to large openings such as doors, windows, sliding doors, and permanently unshuttered openings,

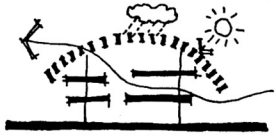
Floor plans



loosening-up of the plan

compact planning

Section

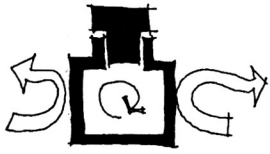


cross-ventilation and sunshading

sunlight and internal microclimate

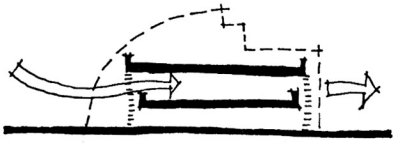
Analogy

Filter Valve analogy



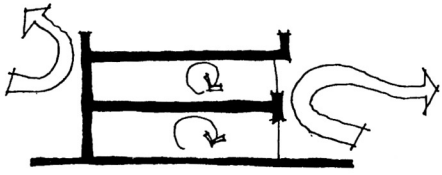
Thermos Flask analogy

Relationship of internal spaces with external environment



selectively filtered
internal microclimate

Open System



hermetically sealed
internal microclimate

Closed System

as well as to perforated surfaces such as louvred walls. An understanding of these provides sources for creative development in regionalist design.

In the hot-humid tropics, the movement of air is the only available relief from climatic stress and is thus vital to indoor comfort. This principle is clearly understood in the high ceilings and in the design of the building cross-sections in the colonial administrative buildings and Chinese mansions in Malaysia. The openings in the tropical enclosure need to be sufficiently large for breezes and also orientated so as to catch whatever air movement there is. Failing to do this produces indoor conditions always warmer than a shaded external space which is open to air movement.

The application of these principles are also evident in the traditional Malay *kampong* houses. The floors are raised above ground level and the spacing of the floor boards are such that ventilating wind is permitted through, flowing through the internal space and upward towards the eaves. The sides of these houses have ballustrades, small timber blinds or curtains and louvred shutters that work as regulating valve elements that can be adjusted to control the internal micro-climate.

In designing with climate, the inclusion and filtering of natural ventilation through the enclosural system has three distinct functions: supply of fresh air, convective cooling, physiological cooling. The requirements determining the volume of fresh air are governed by the type of occupancy, number and activity of the occupancy and by the nature of the activities carried out in the space. In the conventional situation, adequate air supply can be ensured simply by adjusting the doors, windows, flaps and vanes in the louvred panels. If however there is a large difference between the externally given and internally created comfort conditions, the air exchange rate across the environmental filter must be better regulated. Often a degree of control can be achieved by the occupants opening and closing the operable devices at will to keep the indoors cooler than the outdoors.

In convective cooling, the exchange of indoor air with fresh outdoor air can provide cooling, provided the latter is at a lower temperature than the indoor air. The moving air acts as a heat carrying medium. Convective cooling is not a practical proposition in warm climates when the internal heat gain or solar heat gain through the window raises the indoor temperature.

Physiologically, the movement of air across the human skin surface accelerates heat dissipation two ways: increasing convection heat loss, accelerating evaporation. The cooling by air movement is most needed where there are no other forms of heat dissipation available, when the air is as warm as the human

Comparison of Open and Closed Systems
A comparison of the differences in design approaches to dealing with the plan, section and enclosure in the closed system analogy and in the open system analogy.

skin and when the surrounding surfaces are also at a similar temperature.

In the hot-humid tropics, the designer should try to capture in the planning of the spaces as much of the available wind as possible into the building. When the wind is excessive, negative control is easy if the valves in the environmental filter can be adjusted, eg. the windows, louvres and openings. Numerous devices can be found in the vernacular architecture for increasing the internal air flow. These provide a rich source for creative reuse in contemporary contexts.

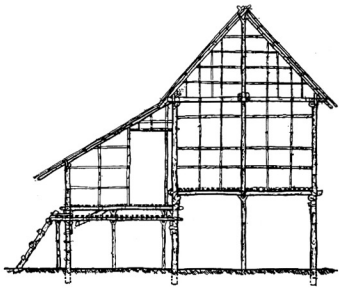
As no satisfactory and complete theory of air flow through buildings is available, air flow patterns can only be predicted on the basis of empirical rules derived from measurements in actual buildings or in wind-tunnel studies. Generally, the following factors affect the indoor air flow (both patterns and velocities): *orientation of the building, its external features, its cross-ventilation, the position of openings, the forms of control of openings.*

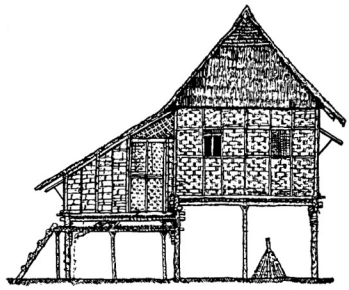
To further facilitate the wind flow through the environmental filter, the critical *cross-section* of the building should align with the prevailing wind direction. Generally, the greatest pressure on the windward side of a building is generated when the elevation is at right angles to the wind direction, so it seems to be obvious that the greatest wind indoor air velocity will be achieved in this case. Thus the designer in making full use of the natural conditions must ascertain the prevailing wind direction and orientate the building enclosure in such a way that the largest openings are facing the wind direction. In the absence of an outlet opening or with a full partition in the cross-section, there can be no effective air movement through the building even in the case of strong winds. With a windward opening and no outlet, a pressure similar to that in front of the building will be built up indoors, which could make conditions even worse, increasing discomfort. In intensive urban conditions, the full attention to orientation for wind flow may not be possible due to site conditions and adjoining structures.

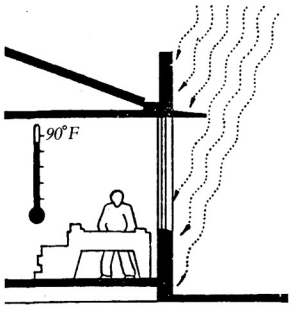
In designing the external wall of the building as an environmental filter, attention must be given to the openings and perforations in the wall to filter in the wind flow. To be effective, the position of openings and perforations must ensure that the air movement be directed at the body surface of the inhabitants. This means that air movement must not be obstructed through the space mostly used by the occupants, e.g. through the living zones. If for instance the opening at the inlet side in the environmental filter is at a high level, then regardless of the outlet opening position the air flow will take place near the ceiling and not in the living zone. The relative magnitude of pressure build-up in front

The Traditional Responses to Climate

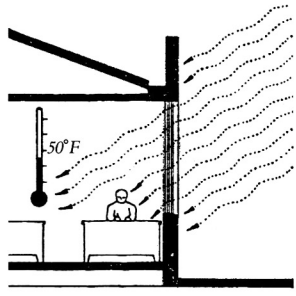
The Malay house functions inherently as enclosural filter: floor is raised on stilts with floor boards sufficiently spaced to permit ventilation; louvred window shutters used in combination with ballustraded openings with internal curtains or blinds working as operable parts; shading eaves and ventilated roof; others. The development of zee-section roof and wall can be regarded as an indirect historical linkage of filtering principle in vernacular structure with contemporary technology.



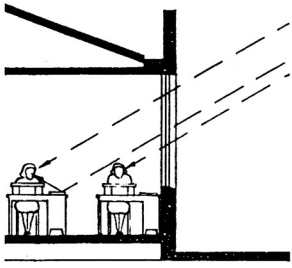




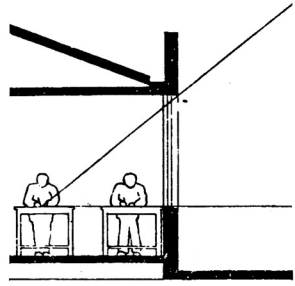
Exclude undesirable radiant heat.



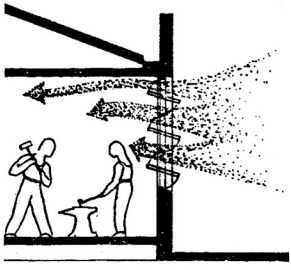
Admit radiant heat when desirable.



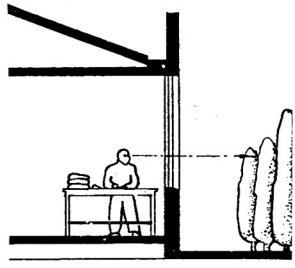
Eliminate direct and reflected glare.



Maintain adequate natural lighting.



Avoid interruption to natural ventilation.



Permit distant vision for eye relief.

of the solid areas of vertical surface of the enclosure (which in turn depends on the size and openings) will in fact govern the direction of the indoor air stream and this will be independent of the outlet opening position.

Generally, in the design of the size of openings for a given elevational area and a given total wind force, the largest air velocity will generally be obtained through a small outlet opening with a large outlet. This is partly a result of the total force acting on a small area, thus forcing air through the opening at a high pressure due to the 'venturi' effect: as in the broading funnel (the imaginary funnel connecting the small inlet to the larger outlet) the sideways expansion of the airjet further accelerates the particles. The best arrangement in the enclosural design is to have the full wall openings on both sides of the enclosure, with adjustable regulating valve devices such as sashes or closing flaps to assist in channeling the air flow in the required direction following the change of wind. An analysis of the cross-section and the partitioning plan in the traditional Chinese shophouse indicate an inherent understanding of this principle.

We can also use supplementary devices for physiological cooling by air movement within the environmental filter by directing an air-stream of substantial velocity at the body surface using fans, whether table-top, free-standing or internal ceiling-mounted. These do not provide air exchange, but generate an air movement. Other forms of cooling can be the use of evaporative cooling by the use of water. Examples in traditional architectural are in the use of 'wind-catcher' devices, evaporating-pools near door openings, etc. The wind-catcher device might for example be adaptively used in the contemporary urban context to take advantage of the high wind velocities in the high-rise conditions.

In the filter analogy, such devices at the openings of the enclosure as sashes, louvres and other elements controlling the openings in traditional buildings influence the indoor air flow pattern and act as *regulators*. Sashes can divert the air flow upwards. A reversible pivot sash will channel it downwards into the living zone. External appendages to the enclosure such as canopies can eliminate the effect of pressure build-up above the window, thus the pressure below the window will direct air flow upwards. For instance, a gap left between the building face and the canopy will ensure a downward pressure, thus a flow directed into the internal spaces. With louvres and shading devices, the position of blades in a slightly upward position will still channel the flow into the living zone.

Insects also need to be excluded in the enclosure by using such things as fly screens or mosquito nets. Without them insects would gather around the internal lamps. As in a filter, such screens

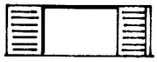
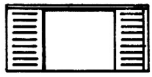
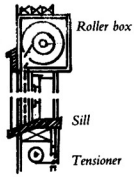
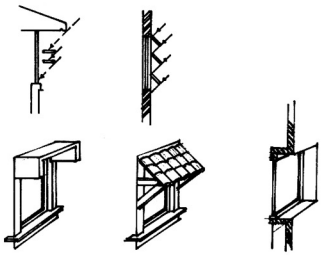
and nets permit air to flow through but exclude the insects. They can, however, substantially reduce the air flow. The reduction is greater with higher wind velocities and is also increased with the angle of incidence. These devices can again be creatively adapted to contemporary situations.

The problem of the exclusion of rain by the environmental filter is not a difficult task and making provision of air movement does not create any particular difficulties, but the two together simultaneously requires resolution. Opening of windows during periods of wind-driven rain would create unacceptable conditions indoors. The conventional tilted louvre blades profile of the filter could become unsatisfactory on two counts: strong wind will drive the rain, even upwards through the louvres, and the air movement will be directed upwards from the living zone. A lip might be added to the ends of the tilted louvre to exclude the wind-driven rain. Various profiles of louvres can be developed to effectively filter the elements in which the ventilating air is permitted through but rain is excluded (eg. the Z-shaped profile).

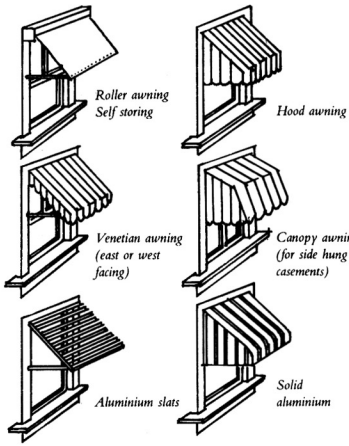
Verandahs and large roof overhangs provide buffer zones between the inside and the outside and are perhaps the best traditional methods of protection. Where organic materials such as timber are used, protective coatings of alkyd resin woodstain are required against weathering and insects attack. The verandah-way in the traditional Chinese shophouse and the Serambi in the Malay *kampong* house serve such a function. Unfortunately much of contemporary development has eliminated these traditional zones through road widening and setback requirements by the local authorities.

In humidity control, dehumidification is only possible by mechanical means. Without this, in warm humid climates some relief can be provided by air movement. In hot dry climates, humidification of air may be necessary and can be associated with evaporative cooling. However some form of air supply to the building interior is necessary. All these functions, such as controlled air supply, filtering out sand dust; evaporative cooling, humidification are served by a device used in some parts of Egypt which is the wind scoop. The large intake opening captures air movement above the roofs in densely built up areas. The water seeping through the porous pottery jars evaporates, some drips down onto the charcoal placed on a grating, through which the air is filtered. The cooled air assists the downward movement, a reversed stack effect. This device is very useful for ventilation (the above four functions), but it cannot be expected to create an air movement strong enough for physiological cooling.

In our perceiving the building envelope as a filter between the internal controlled environment and the external conditions, it is

Device	*Advantages*	*Disadvantages*
Solid shutters 	*All direct radiation is excluded* *Easy construction and maintenance* *Hail, storm and theft protection* *Heat and cold barrier* *Can be retrofitted*	*No light or ventilation* *No view* *Can only be operated by opening window* *Rattle in wind* *Inclined to sag*
Louvred shutters, wood or aluminium	*Subdued light, privacy and ventilation*	*Wood requires repainting*
Side-hung shutters 	*Good thermal performance* *Easy installation*	*As above*
Sliding shutters 	*Less likely to sag*	*Need more expensive gear*
Sarasota shutters 	*No sky glare* *Good view* *Adjustable to seasonal needs*	*No privacy*
Bahama shutters 	*Privacy and easy operation* *Many shading options* *Burglar proofing* *Hail and storm protection* *Metal slats offer fire resistance* *60 dBA noise reduction* *Operated from inside*	*No view*
Roller shutters, wood or metal 	*Good U-values* *Reduced glare* *Hail protection* *Platform for window cleaners, fire escape* *Solar heat gain on windows reduced by 80 per cent* *Shading on walls reduces thermal stresses and saves energy.*	*Complicated installation* *Maximum span 3600 mm* *Wood requires maintenance* *Obstructed emergency exit*
Architectural projections, equatorward; horizontal; east and west: vertical 	*Inexpensive, can be retrofitted* *Adjustable, can be retracted* *Good device for east and west windows* *Reduced glare, pleasant light quality.*	*Narrow louvres (150 mm) cause heat build-up* *Brise-soleil are thermal bridges and dust collectors.* *Some brise-soleil howl in the wind* *East and West louvres obstruct view*

Device	*Advantages*	*Disadvantages*
Awnings, aluminium or canvas	*Adjustable* *Can be retrofitted*	*Canvas damaged by UV rays* *Efficiency reduced by dust* *Prone to hail damage* *Canvas lasts 4–6 years*



Window Shading Devices
An analysis of the range of window shading devices that are existing in the vernacular that can be creatively adapted for contemporary building programmes.

a selective barrier that excludes the unwanted influences whilst admitting those which are desirable. Besides the filtering of wind, rainfall, insects; the filtering function also applies to light. The source of daylight is of course the sun, from which we receive also a large amount of thermal radiation together with light. In a climate where the heat balance is negative (i.e. overheating is not likely), thermal considerations will rarely restrict the amount of daylight to be admitted. However in the tropics, the situation is not quite as simple. Here the admission of an abundant quantity of daylight will be accompanied by radiant heat which is probably excessive. Thus the filter function of the envelope becomes more critical in design. The design needs to exclude radiant heat whilst admitting daylight. Where this cannot be done, thermal considerations will restrict the amount of light which can be admitted. This means that there must be a fundamental difference in approach to daylighting design.

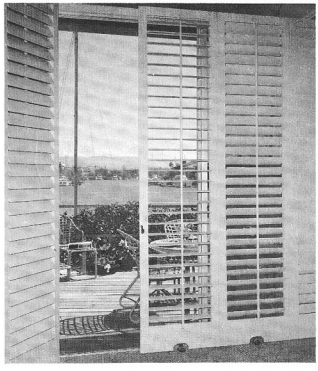
In warm-humid climates the sky is typically overcast (e.g. with a luminance often exceeding 7000 cd/m^2). The proportion of diffused or sky-light is predominant and the very bright sky viewed from a moderately lit room can cause discomfort glare. The task and problems of filtering daylighting in tropical climates can be summarised as follows: firstly, to provide adequate daylight, even if the windows are protected by louvres or grilles for thermal reasons; secondly, to exclude from the visual field excessively bright (light-coloured, sunlit) surfaces, which would cause glare.

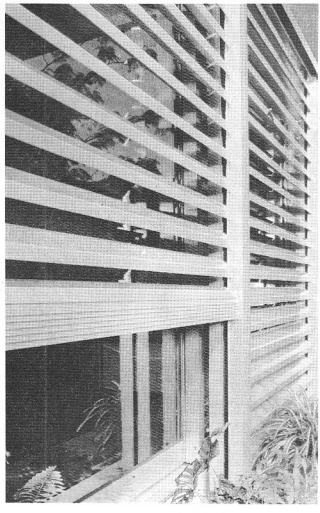
Direct sunlight should be excluded in the tropics for the thermal reasons. The sky is bright and can provide sufficient light, but its high luminance also causes glare. For this reason, the view of the sky should be screened by additional shading devices or plants. Sky luminance in this zone is, however, much less near the horizon than at higher altitude angles.

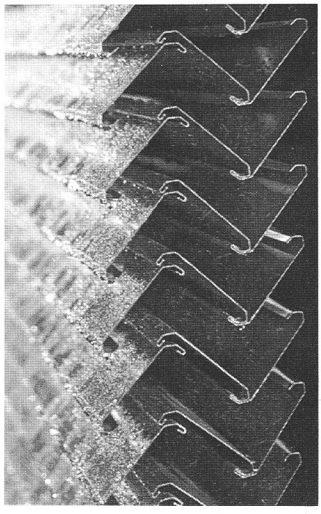
In the tropics, the greatest sources of heat gain is the solar radiation entering through the openings. This could in fact increase the indoor temperature far above the outdoor air temperature even in moderate climates. In the principles of designing with climate, there are four traditional methods for the reduction of solar heat gain through the openings of the enclosure: *proper orientation of the building surfaces and openings; opening size; internal filter devices such as blinds, curtains, louvres, special glass; and external shading devices.* In the Equatorial zone, if solar heat gain is to be avoided, the common traditional practice is to ensure that the main windows face north or south. Only minor openings of unimportant rooms should be placed on the east and west side. Solar heat gain on the west side can be particularly troublesome as its maximum intensity coincides with the hottest part of the day. Solar sieving devices to shade, screen and exclude the solar radiation can be of these basic types of filter configurations: *vertical, horizontal and egg-crate.* The designer can further develop these devices in combination with filtering other elements.

Although the intensity of solar radiation is normally less in the tropics than in the hot-dry regions, it is nevertheless a significant source of heat. Thus its entry across the enclosure should be pre-

Operable Valve Components
Below: Adjustable louvred door panels.
Below, right: Solar cell controlled blinds that are automatically lowered or raised depending on the solar position and time of day.
Below, far right: Various modifications of Zee-profile in metal louvred panels that can be used as walls and roofs.
Various readily available building components in the market that can be used or adapted as valve parts in designing the environmental sieve.







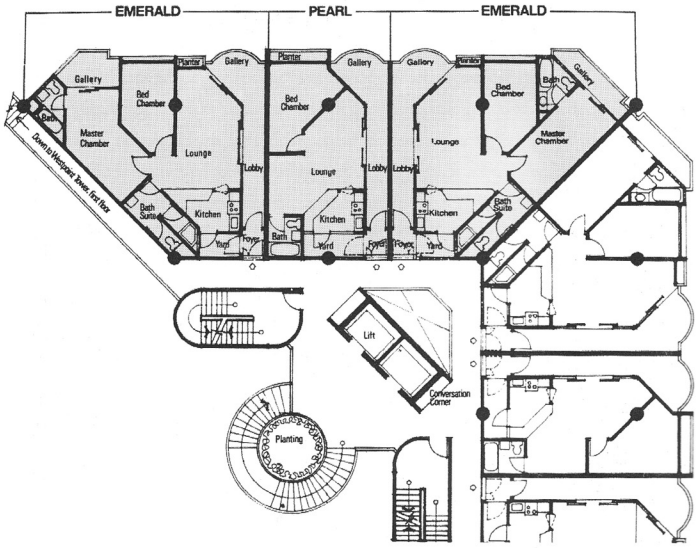
vented. In hot-dry climates the radiation is mostly directional and the shadow angles can be established in quite precise terms. Here, much of the radiation is diffused and comes from the whole of the sky hemisphere. Thus the filtering and shading devices should provide a greater coverage, obstructing most of the sky and not just the location of the sun. As the openings are far larger than in hot-dry climates, these devices should be much larger on both counts. Openess and shading will be the dominant characteristics of the building. Further, the filtering of solar radiation by shading of all vertical surfaces of both openings and solid walls will be beneficial. This task will be much easier if the building floor height is kept down. Very often the overhang should extend far beyond the line of the vertical face, providing the necessary shading to both openings and wall surfaces. This is clearly evident in the deep eaves of the traditional timber and tiled roofs of the vernacular.

From the point of view of solar heat gain, the best arrangement has been found to orientate buildings with the long axes in east-west direction, the long elevation facing north and south to reduce exposure to the sun. This may often conflict with the requirement of orientation for wind or with the design programme itself. Such a conflict might be subjected to further analysis in individual cases, as there is no generally applicable rule. It must be remembered however, that the solar geometry cannot be changed, but our skillful use of built elements, e.g. screen walls, or even a projecting wing of building, can change the direction of air movement. With low rise buildings, where the walls would not get much radiation, orientation for wind is more advisable. With high-rise buildings the opposite is true, with avoidance of sun being the greater decisive factor.

By opening up the enclosural system as a filter and increasing the air flow spaces for air movements to outside conditions, the influence of thermal heat of structure upon indoor conditions is lessened considerably. The upper horizontal roof plane of the environmental filter is practically the only element which has a very great significance. The increased air flow cannot improve the conditions significantly, i.e. it will not produce temperatures cooler than the outdoor air, but if correctly designed can prevent the indoor temperatures increasing above the outdoor air temperatures, and keep the cooling temperature around the same level as other surfaces. Keeping the roof plane cool can be achieved by a reflective upper surface with a ventilated roof-space, having a good resistive insulation. This can also be achieved with a *double-roof* construction, e.g. a roof terrace with a louvred pergola filter over it. In this way the roof surface also becomes useable as a roof garden or terrace.

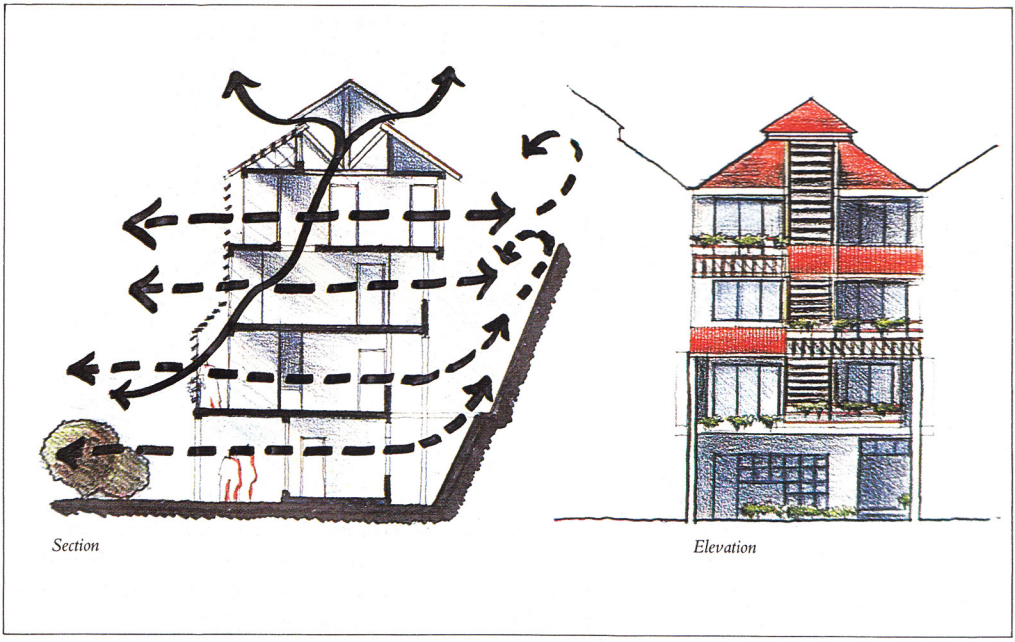
The Terrace as a Climatic Conduit
One way to bring climate into the insides of the high-rise building archetype is to position the balcony and terrace spaces at right angles to the face of the building instead of parallel to the building face.

For the solid (unperforated) vertical wall planes, insulation is not necessary if they are shaded by eaves or overhangs. If however these planes are exposed to solar radiation (such as gable walls), some extent of insulation will prevent the elevation of the inner surface temperature above the air temperature. As a mediator between the inside and the outside environment, the use of reflective qualities on the outer surface of unshaded walls would further contribute to the control. As with the devices that are used to keep the roof plane cool, a double-wall screen system could be used in which a secondary screen (a vertical pergola) can be placed in front of the inner wall plane.



Left: Inversion of the balcony to be at right angles to the floor plan.
Below: Louvred Tropical Dress.

The Circulation Zones
Below, left: Circulation areas as conduits for ventilation.
Below: Filter wall to circulation areas.



Section

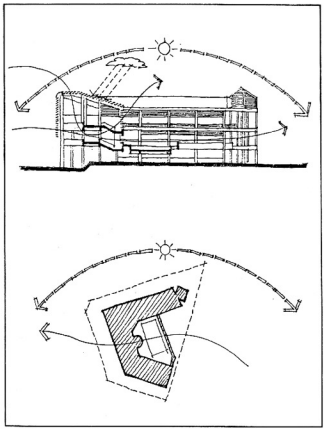
Elevation

One of the most difficult problems which a designer must solve in designing the environmental filter is to provide large openings to encourage wind flow but at the same time give protection from driving rain, insects, smell and noise. The environmental filter enclosure would need to have a number of layers of *secondary filtering devices*. In designing the openings and perforations in the filter certain criteria must be brought together, such as size of openings and perforations; profile of the filter; plane of the enclosure (e.g. vertical, horizontal, indirect); orientation and position of built form; associated shading devices; insect or fly screens; security devices and grilles; adjustable control devices.

All these attributes and components mutually effect each other. The openings and profile of the enclosural filter together with its various control devices as a complete unit, must satisfy user requirements such as ventilation and air movement; closure for exclusion of air at times; daylight admission and glare control; solar heat exclusion; insect, pest and burglar proofing; view and visual effects. Added to these would be of course, the cultural and socio-economic influences of the place.

The design of openings and perforations gives perhaps the most complicated and difficult tasks in the designing the environmental filter, regardless of whether these are regarded in the design process as conventional doors and windows or as a filter screen. Weighing of the requirements might be necessary. Local micro-climatic factors of the place will dictate which of the requirements are the most important. The openings in the conventional filter can then be designed in these terms: When all other factors are also satisfied (e.g. louvres, insect screens and burglar bars are added) the designer might check back, whether the original requirement (e.g. air movement) is still adequately provided for. For instance, some adjustment by a further increase in opening size, or partial obstructions may be necessary.

Variable Louvred Profiles over Circulation Area
Design explores different wall profiles to relate to various internal space uses: vertical slats, vertical slats with glazing, inclined slats, zee-shaped profiles, tiered trays, glass louvres, hoods.



When daylighting is considered together with the ventilation requirements in the design of the enclosure, some further resolution is needed. In moderate climate, the light admitting area would need to be larger than the area needed for ventilation. The solution would be for fully glazed windows with some fixed glass panes and only some of the windows openable. However in the tropics, and particularly in composite climates, the reverse is true. Much larger opening is necessary for ventilation than for daylighting, requiring large openings, fully openable, with some of the closing devices such as glazing and sashes and other solid or opaque shutters.

The discussions here on the consequences of the armature direct our attention particularly to climate as one of the dominant endemic factors of a place, on its influences on human comfort and

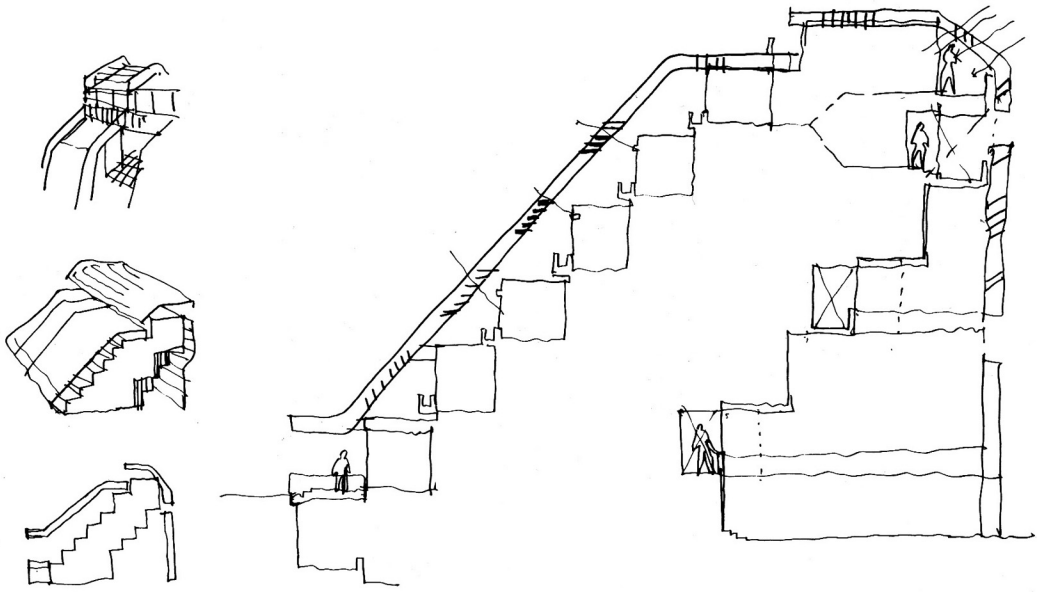
its exchanges through the building envelope. Subsequent design trade-offs might need to be made especially in meeting the other influences of the place. The synthesis may not result in an absolute satisfaction of the entire set of requirements, and the resolution may require corrective measures in the design of the enclosural system to rectify the trade-offs.

The armature's applicability for our exploratory regionalist design interpretations rests in its basic role in describing the enclosural functions in terms of *general systems* and *functions*. In this way by starting from a systemic basis of the enclosure, it permits regionalist design development without a prior determination of a particular preconceived style or form. For instance, a regionalist architect could develop the built form design from the configurations of the ventilating gable-roof device derived from the vernacular. More important is that the armature provides the designer with a *framework* for experimentation and for inventive development of the technics of the tropical enclosure. If for instance, we hold a design approach that views the enclosural system of a building as a total continuous envelope, our interpretation of the analogy could be as an articulated web-like variably-textured enclosural-skin system which has sieving and operable devices critically located on the enclosure shaped to synchronise with the needs of the internal space use and the fluctuation of the external natural conditions (both seasonal and daily). Whereas say, if we hold an incremental or piecemeal concept of the enclosural system, the interpretation could be an adhoc assemblage of connected but different filter and valve devices.

We should of course be aware that the technics of the enclosural system form only part of the total considerations in building design. The various climatic design implications of the filter analogy discussed here need to be further related to the connec-

Below, left: The Pedestrian
The man-in-the-street remains the imperative criteria for the regionalist urban archetype: his acceptable level of comfort both internally and externally; accessibility within buildings, between buildings and in city; acceptable level of protection from climatic elements; perception of spaces and forms; needs for private, public and semi-private transitional zones; economic aspirations and social customs.

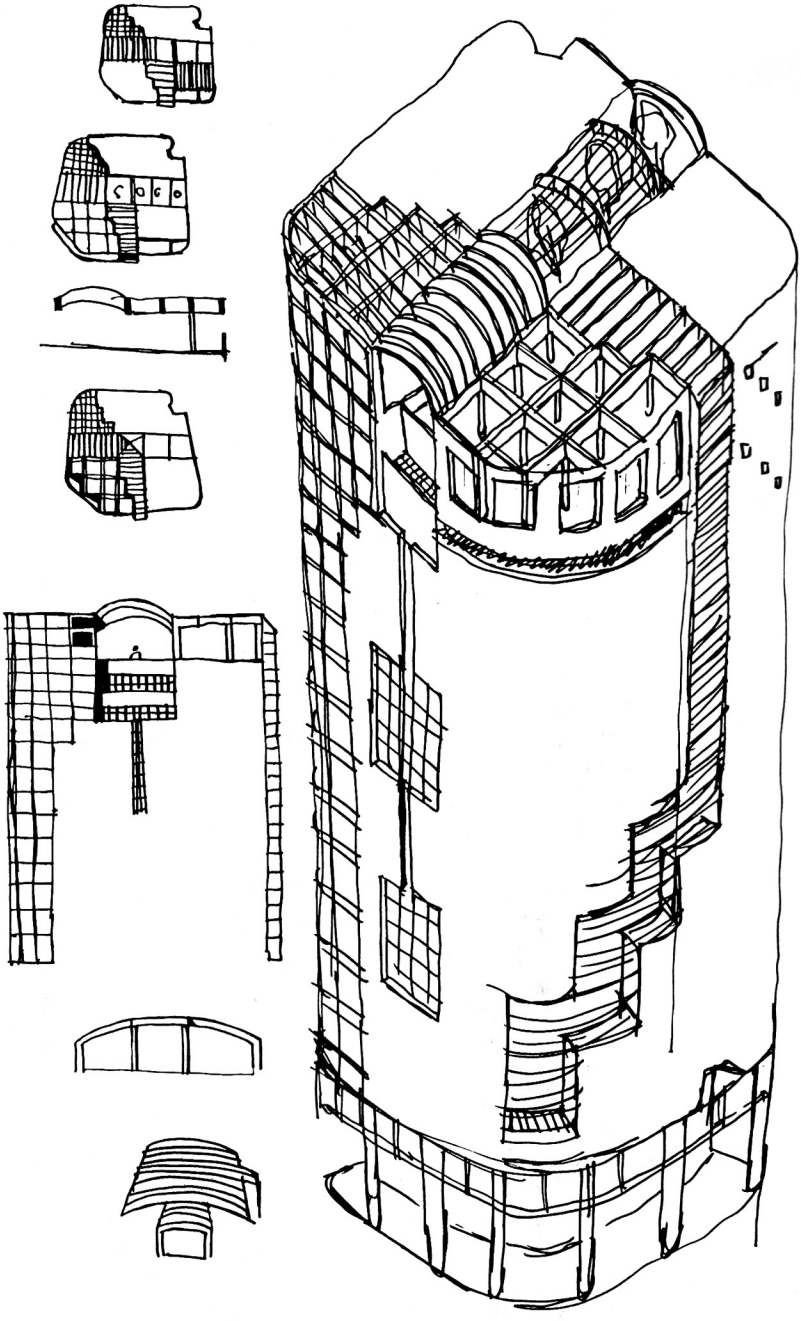
Below: The Umbrella Analogy
The umbrella remains a self-evident important model of the function of tropical enclosures e.g. as in-between spaces and partial enclosures that give protection from the hot tropical sun and rain, and permit ventilation underneath.



Exploratory sketch of a continuous web Filter-Wall over a setback building section

tions that the forms, assembly and aesthetics of the enclosural system would seek to make with the cultural traditions and the architectural heritage of the place, the various other social and economic requirements of the contemporary building and its programme, the constraints and opportunities of the site, as well as also the real problems and issues of that particular society and culture. However, in seeking to design with the climate of the place, an indirect connection with one of the dominant endemic factors of the place is made. Subsequently in the design process, a further analysing and developing of the filtering roles of the forms and devices from the architectural heritage takes place, in which case there would be a further direct linkage with the architectural tradition.

We might hope that the armature would enable the wider development and understanding of regionalist architecture, one that would use the appropriate technology but which belongs and performs to the region and place. In the process of giving form to the regionalist connections, the results that emerge might appear immediately visually unfamiliar despite the intentions and sources of forms and devices. We must be prepared for this if a new architecture is to emerge. More important is if it is responsive to the local environmental, cultural context and those problems of that society; then by being responsive it works, it is authentic and it contributes to the locality.



Exploratory sketch of the Filter-Wall as an assemblage of various valve devices that are related to internal space use.

AUTHOR

Born in Penang, Malaysia, Ken Yeang had his early education at Cheltenham College and studied architecture at the Architectural Association. This was followed by brief landscape planning studies at the University of Pennsylvania under Ian Mcharg, and research work for Doctorate at Wolfson College, Cambridge.

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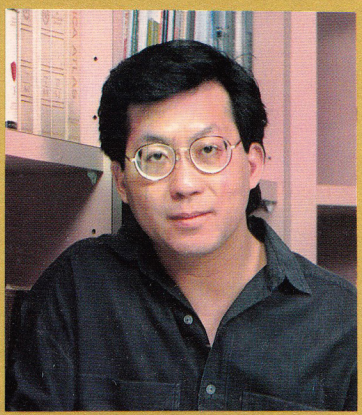
Chairman of ARCASIA (Architects Regional Council Asia), 1986–1988, he was the Past President of the Malaysian Institute of Architects and Past Vice-President of the Commonwealth Association of Architects.

Ken Yeang is also the author of the book *The Tropical Verandah City: Some Urban Design Ideas for Kuala Lumpur* first published in 1986 and now being reprinted by Longman. He has published papers in the AAQ (Architectural Association Quarterly) and Architectural Design.

Ken Yeang is committed to the pursuit of a Malaysian architecture and the development of the Malaysian and Asian architectural profession.



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